Arth Ganga Project: District Uttarkashi

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EXECUTIVE SUMMARY

Uttarkashi, a spiritual and religious city located on the banks of Bhagirathi is located in the state of Uttarakhand. The city is located on the confluence of Varuna and Assi and shows cultural and spiritual resemblance to Kashi (a city in the state of Uttar Pradesh).

The total geographical area of the district is 8016 Km^2, out of this the permanent pastures are 8300 ha, the Cultivable wasteland is 2300 ha. The barren and uncultivable land constitutes 37600 ha. The share of barren and uncultivable land has increased from 4.86% in 2009-10 to 4.97% in 2015-16. Majorly based on the extent of erosion soil types are highly varied, mostly loam. With the net sown area of 30800 ha and gross cropped area of 47500 ha, the Cropping intensity of the district is 170%. The irrigated area with canal or other sources is 62600 ha and 37400 ha. The major crops types are Wheat, Rice, Paddy, barnyard millet, finger millet, black gram, pea, mustard, etc. Among the horticulture crops are apple, peach, plum, citrus fruits, dry fruits, etc. along with vegetables. Total fertilizers use ranges from 0.96 to 1.58 kh/ha of GCA. The livestock consists of indigenous and crossbred cattle and goats, buffalos, goats, sheep; along with poultry and fisheries. The district economy grew with an average annual growth rate of 7.07% during 2011-17 with the main contribution of the secondary sector (6.79%) followed by the tertiary sector (8.36%). Mining and Quarrying recorded a positive growth of 4.17% and so did the livestock with a positive growth of 4.15% per year. The share of the agriculture sector went down from 53.55% to 38.79% whereas the share of livestock rose from 17.56% to 23.982% from 2011-12 to 2016-17 respectively.

The district is the host place of Yoga which attracts thousands of visitors every year. Few lakes, Govind Wildlife Sanctuary, and temples aid in the tourist attractions of the district. Trekking, water sports, mountaineering, etc. are the adventures that enthrall many tourists every year. The total forest cover in the district is 3036 Km^2 out of which, 614.67 Km^2 comes under the very dense forest category, 1706.86 Km^2 is moderately dense forest, and 714.47 Km^2 area is open forest. Between 2010 and 2020, the area under open forest and dense forest marginal increased from 919.81 km^2 to 960.38 km^2 and 2949.94 km^2 to 2970.65 km^2 whereas cropland, a forest plantation, and scrubland area marginally declined by 0.13%, 0.34%, and 0.27%. The forestry and logging share increased from 28.83% to 37.16%, with an annual average growth rate of 3.13% and fishery grew by 5.65% during the study period. The number of flora and fauna is 611 out of these, a total of 332 species are present in the district. The district comprises 58 wetlands; the maximum wetlands available in the district are natural.

The main source of lightning is electricity (80%) and the major source of fuel is firewood (65%) followed by LPG/PNG (32%). Biomass production is high owing to animal and agricultural waste. Biogas potential from animal waste and agricultural waste is calculated approximately as 39 lakh m^3/year and 1 crore m^3/year respectively. Different solar projects have been inaugurated and many solar appliances are brought into use yet only 2.45% of people use solar power as electricity.

Owing to the several small and large rivers in the district there are many small and large hydropower projects announced and under construction in the district.

There have been many active measures taken to support and promote sustainable development which shows the government's strenuous efforts to comply with green and clean strategies along with economic development yet lack of monitoring, local participation, expansion of measures like agroforestry, etc. are some of the barriers that are needed to be overcome. Thus, practices like drip and sprinkler irrigation, cluster farming, organic farming; adopting modern technologies, increasing aromatic and medicinal plantations, enhancing animal husbandry productions, etc. should be taken into consideration.

1 DISTRICT OVERVIEW

1.1 INTRODUCTION

Uttarkashi district is a district of Garhwal division of the Uttarakhand state in northern India. The district lies between latitude 30º28' and 31º28' North and longitude 77º49' and 79º25' East. Its maximum length from east to west is about 154 kms. and maximum breadth from north to south is about 109 kms. It is surrounded by district Chamoli in the east, on the north are Himalayan Ranges and state of Himachal Pradesh with international boundary formed by China (Tibet) and on the west is Dehradun and State of Himanchal Pradesh. On the south, districts Tehri Garhwal and Rudraprayag are situated. The total area of the district is 8016 sq.km. and area wise it is the largest district of the state Uttarakhand. Administration wise the district has 6 tehsils includes Rajgriha, Bhatwadi, Chinyalisaur, Dunda, Purola and Mori.

A huge chunk of revenue of the district comes from agriculture, forest products, animal husbandry, sheep rearing and cottage industry. Agriculture is not flourishing much in the district since most of the land being covered by either forest or uncultivated land. The most important cottage industry is the production of wool and wooden goods. Other cottage industries include basket making, mat weaving and wood craft. Tourism industry also contributes to the economy of the district.

In the year 2019, there was a total 37.87% forest area of total geographical area. The varying climate and topography produce a range of vegetation and serve as habitat to diverse species of wild life. Forests occupy a place of pride in the environment of the district not only for the sheer bulk of the area they occupy but also for richness of variety of vegetations. Deodar, Sheesham, Cheer and Bamboo are the main forest produce besides Jhula grass extracted from Moru tree. Medicinal plants of great commercial value grow spontaneously in the forest.

The cultivation in the district is carried by making terraces on the sloping hill side. Some cultivation is done on steephill also where terracing and tilling can't be done and the place is cleared by burning shrubs and bushes. The seeds are sown with the help of hoe. Rabi and Kharif are the main crops. Besides wheat, paddy, maize, madua and sawa are being cultivated in the district. Wheat is sowed in about 78 per cent of the total cropped area during Rabi. The production of commercial crops like potato and oil seeds bears significance. Urad, masoor, matar and arhar are also harvested. Among fruits, apples comprise 80 per cent share mainly in the development blocks Naugaon, Bhatwari, Dunda, Chiniyalisaur, Puraula and Mori.

There were 330,086 persons in the district in 2011 Census. As much as 92.64 per cent population of the district live in rural areas and rest reside in urban areas. The sex-ratio (females per 1000 males), which was 941 at the 2001 Census, has improved to 958 in the 2011 Census. The literacy in the district is at 75.8 per cent at the 2011 Census, quite low to the state level of 78.8 per cent. Total workers in the district are 157,276. In rural areas there are 149,067 workers as against to 8,209 workers in urban areas.

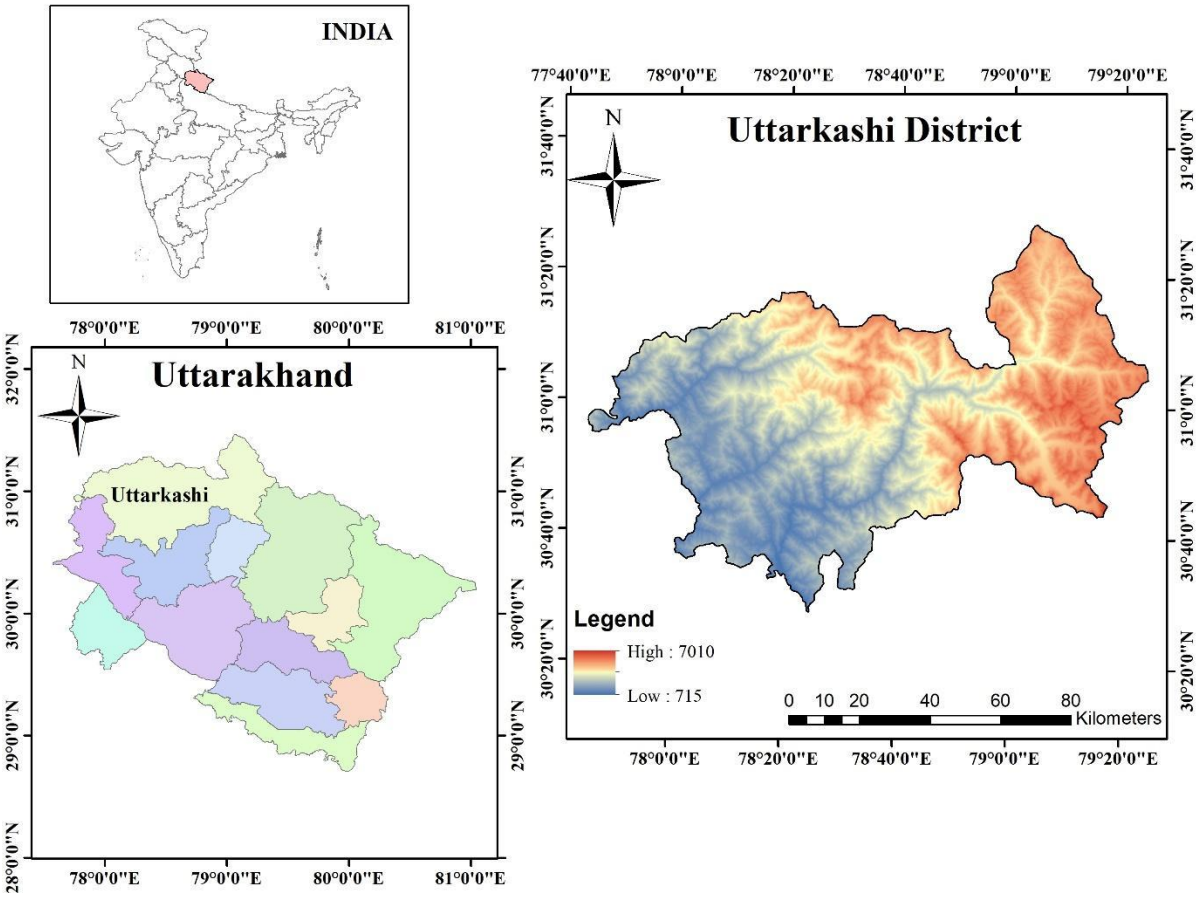


Figure 1 Map of the district

Two major rivers of India pass through the state, namely Bhagirathi (Ganga) and the Yamuna. Agriculture and animal husbandry are the main sources of income of the rural people of the district.

The agricultural activity is restricted in the valleys region, mild hill slopes and intermontane valleys. In the steep slopes, where terracing and tilling is not possible, the seeds are sown with the help of hoe. The major food crops grown in the district are paddy, wheat, maize, Mandawa, sava (coarse millet), rajma, urad, garath, soybean, mustard, and til. The vegetables grown are potatoes, tomatoes, radish, cabbage, cauliflower, brinjals, french beans, and cucumbers; the fruits are apples, peaches, walnuts, apricots, citrus fruits, pears, and plums. The major sources of irrigation are the springs, gad, gadheras and rivers. Groundwater is not available for irrigation. Animal husbandry is another important source of income for rural people. Of the total livestock, the bovine population and that of sheep accounted for almost one-third each. The production of milk is very low due to poor infrastructure and markets.

Topography and Soil

The district's topography is highly mountainous. The average elevation of the district varies 715 to 7010 m from mean sea level. The northern and eastern part of the district is covered with the snow throughout the year.

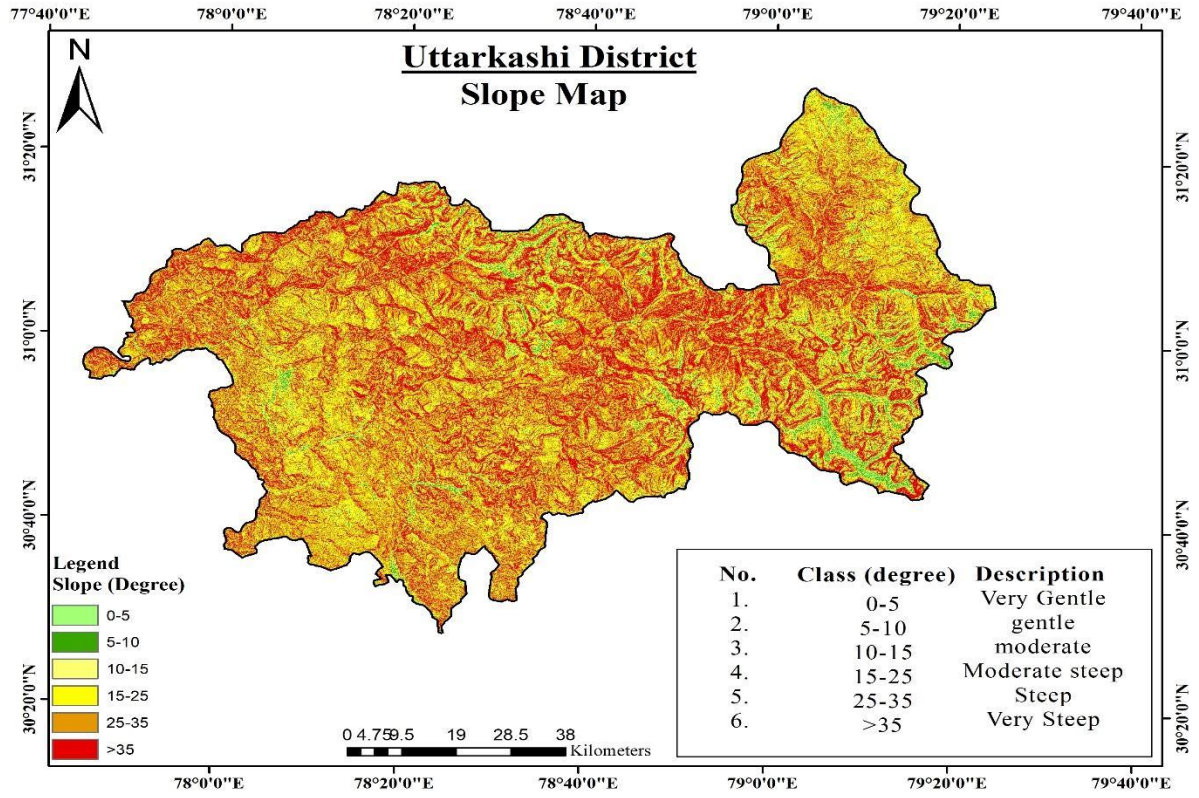
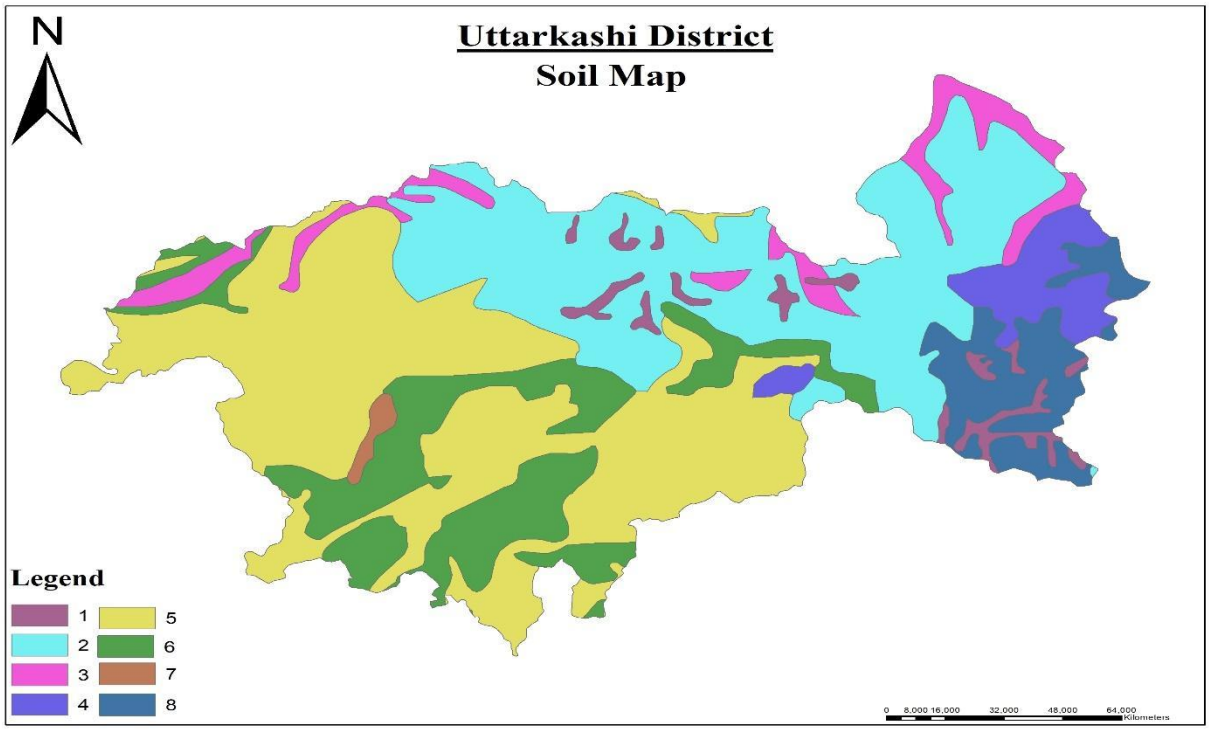


Fig. 2 Slope map of the Uttarkashi districts

The soil types are controlled by the topography and rock types. The soils, on the Summits and Ridges, are shallow to moderately shallow, excessively drained, sandy, loamy-skeletal. The soils are slightly to moderately acidic in nature. The soils occurring on very Steep slopes are very shallow to shallow, excessively drained sandy/loamy-skeletal/ loamy without soil development



with Lithic contact within 50cm of the surface. They are slightly to moderately acidic, very severely eroded, strongly stony with low available water capacity. The upper

S. No	Soil Type
1	Rocky soil
2	Layer of bedrock, no vegetation
3	Bed rock with glacier, no vegetation
4	Most of the soils are sandy-skeletal or very shallow to a paralithic or densic contact. Not suitable for cultivation
5	Shallow to weakly cemented rock or deep or moderately deep to rock and that have deep ground water and low animal activity. The soil is suitable for pasture or forest but are used as cropland
6	These soils have a lithic contact within 50 cm of the surface. The lithic contact is at a depth of less than 25 cm in most of the soils. They are used mostly as pasture or forest.
7	Formed mostly in late-Pleistocene or Holocene sediments, suitable for forest, pasture and cultivation
8	Deposit of pyroclastic materials that is as thick as 18 cm.

(Source: Soil Taxonomy; A Basic System of Soil Classification for Making and Interpreting Soil Surveys)

Fig. 2 Soil map of Uttarkashi District

valley slopes in Galcio-Fluvial valleys consists of moderately shallow, excessively drained, coarse, loamy, slightly acidic and moderately stony. Lower valley slopes, of the glacio-fluvial valleys, are

occupied with moderately shallow, well drained, sandy-skeletal/coarse-loamy, slightly acidic, slightly eroded and strongly stony soils with low available water capacity.

The broader valley slopes, in fluvial valleys, have deep, well drained, fine-loamy, moderately acidic and strongly stony. The narrow valley slopes, on the other hand, are occupied by moderately deep to deep, well drained, coarse loamy, slightly to strongly acidic.

1.2 DEMOGRAPHIC PROFILE OF UTTARKASHI

Geographic area: 8016 Km^2
Altitude: 2620 m
Rainfall: 1165.4 mm
Forest area: 3036 Km^2
Rivers: Bhagirathi, Yamuna

Administrative Divisions:

District Headquarter	Uttarkashi town
No. of Tehsils	6
No. of Blocks	6
Villages	686

Demographic and Socio-economic Parameters:

Population	3,30,086
Population Density	41 / Km^2
Sex Ratio	958
Literacy	81.3% 4
Occupation/Livelihood	Agriculture

Table 1 demographic overview

A huge chunk of revenue of the district comes from agriculture, forest products, animal husbandry, sheep rearing and cottage industries. Agriculture is not flourishing much in the district since most

of the land being covered by either forest or uncultivated land. The most important cottage industry is the production of wool and woollen goods. Other cottage industries include basket-making, mat weaving and wood craft. Tourism industry also contributes to the economy of the district. In the year 2016-17 the gross domestic product in the district was Rs. 3,61,225 lakh at current price and Rs. 2,93,578 lakh at constant prices in the year 2011-2012. The net domestic product in the district during the period 2016-17 was Rs. 3,21,711 lakh at current price and Rs. 2,59,473 lakh at constant prices in the year 2011-2012. The Per Capita Income or NDDP, At Factor Cost in the district during the period 2016-17 was Rs. 89,190 at current price and Rs. 71,935 at constant prices in the year 2011-2012 (IndiaStat).

1.3 AGRO CLIMATIC PROFILE OF THE DISTRICT

1.4 ECONOMIC PROFILE OF UTTARKASHI

The primary sector of the district economy has constantly been declining in terms of its share in GDDP (Table 1). The share went down from 31.23% in 2011-12 to 21.86% in 2016-17, with an annual average growth rate of –1.56 percent. Contrary to this, the share of the secondary sector rose about two percentage points from 24.35% to 26.69% during the same period, thus recording an average annual growth rate of 6.79%. Similarly, the tertiary sector's share increased from 41% to 46.49% during the same period, with a yearly growth rate of 8.36%. Overall, the district economy grew at 7.70 percent per year during the period under study. The real per capita income in the district went up from Rs.68259 in 2011-12 to Rs.81390 in 2016-17, with an annual growth rate of 3.68% per annum. It can be inferred that the people's economic condition depending on the primary sector has worsened vis-à-vis the other sectors.

Table 1: Trends in GDDP and Per Capita GDDP in Uttarkashi at Constant Prices in Rs Lakhs (Base 2011-12)

Year	Sector-wise GDDP (Rs, lakhs)	Annual growth rates		

	Primary	Secondary	Tertiary	Total GDDP	Primary	Secondary	Tertiary	total	Per capita GDP (Rs.)	Growth rate
2011-12	70749	55149	100616	226514	-	-	-	-	68259	
	(31.23)	(24.35)	(44.42)	(100)						
2012-13	59512	59481	103901	222894	-15.88	7.86	3.26	-1.60	66246	-2.95
	(26.70)	(26.69)	(46.61)	(100)						
2013-14	68671	64089	118880	251640	15.39	7.75	14.42	12.90	73590	11.09
	(27.29)	(25.47)	(47.24)	(100)						
2014-15	62394	66872	131650	260916	-9.14	4.34	10.74	3.69	75506	2.60
	(23.91)	(25.63)	(50.46)	(100)						
2015-16	61865	72667	138762	273293	-0.85	8.67	5.40	4.74	77990	3.29
	(22.64)	(26.59)	(50.77)	(100)						
2016-17	63532	77562	149544	290638	2.69	6.74	7.77	6.35	81390	4.36
	(21.86)	(26.69)	(51.45)	(100)						
Average Growth Rates					-1.56	7.07	8.32	5.22	-	3.68

Source: UKDES
Note: Figures in Parentheses are percentage share in the total GDDP

Since our focus is on agriculture and allied activities, we further disintegrate the primary sector GDP to know which sub-sector is laggard and which one is driving the growth of the primary sector. Table 2 shows the sub-sectoral trends in the primary sector. The sector is divided into agriculture and allied activities and mining & Quarrying (M&Q). As stated above, the primary sector recorded negative growth of about 1.56 percent per year, but M&Q recorded a positive growth of 4.17% per year, though the growth shows ups and downs across years.

As far as sub-sectoral growth of agricultural and allied sectors is concerned, we observe that agriculture, including horticulture, declined by 6.68 percent per year during 2011-12 to 2016-17. Consequently, the share of the agriculture sector in total agriculture and allied sectors went down from 53.55% to 38.79% during the period. Contrary to this, the share of livestock rose from 17.56% to 23.982% during the same period. Livestock evinces a positive growth of 4.15% per year.

Table 2: Trends in GDDP from Agriculture and allied activities in Uttarkashi at Constant Prices in Rs. Lakhs (Base 2011-12)

Year	Agriculture	livestock	Forestry & logging	Fishery	Total Agri, & allied	Mining & Quarrying	Primary Sector

2011-12	35677	11700	19206	37	66620	4130	70749
	(53.55)	(17.56)	(28.83)	(0.06)	(100)		
	-	-	-	-	-	-	-
2012-13	24486	13879	17887	38	56290	3222	59512
	(43.50)	(24.66)	(31.78)	(0.07)	(100)		
	[-31.37]	[18.62]	[-6.87]	[2.70]	[-15.51]	[-21.99]	[-15.88]
2013-14	30226	13320	21411	27	64985	3686	68671
	(46.51)	(20.50)	(32.95)	(0.04)	(100)		
	[23.44]	[-4.03]	[19.70]	[-28.95]	[15.45]	[14.40]	[15.39]
2014-15	24386	13035	19830	39	57290	5104	62394
	(42.57)	(22.75)	(34.61)	(0.07)	(100)		
	[-19.32]	[-2.14]	[-7.38]	[44.44]	[-11.84]	[38.47]	[-9.14]
2015-16	22569	13815	20864	42	57291	4574	61865
	(39.39)	(24.11)	(36.42)	(0.07)	(100)		
	[-7.45]	[5.98]	[5.21]	[7.69]	[0]	[-10.38]	[-0.85]
2016-17	22863	14136	21900	43	58942	4590	63532
	(38.79)	(23.98)	(37.16)	(0.07)	(100)		
	[1.30]	[2.32]	[4.97]	[2.38]	[2.88]	[0.35]	[2.69]
Average Growth Rate	-6.68	4.15	3.13	5.65	-1.80	4.17	-1.56

Source: Compile from UKDES
Note: 1. Figures in () are percentage share in the total agriculture & allied GDDP
2. Figures in [ ] are annual growth rates

Notably, forestry and logging contribute significantly to the district's agriculture and allied sectors' GDP. Its share increased from 28.83% to 37.16% during the same period, with an annual average growth rate of 3.13%. Though Fishery has a negligible share in the total GDP of agriculture and allied sectors, it seems to be the highest growing sub-sector in the district economy as it grew at the rate of 5.65% per year. **Thus, livestock, forestry & logging and Fishery (allied activities) are the primary sector's growth drivers, and agriculture is pushing down the growth of the agriculture & allied sectors.** Can crop and horticulture sectors be the growth drivers of the district rural economy? Or should a sustainable development model for the growth of the district economy rely more on livestock, forestry and Fishery? Can organic farming initiatives taken by the government through PKVY and Namami Gange programmes revitalize agriculture and provide a decent livelihood to the rural workforce engaging the agriculture? Or should we think of an integrated model of sustainable development focusing on horticulture, livestock, agroforestry, bio-energy and tourism? How can these activities be integrated into the system and re-enforced? To answer these questions, we need to get feedback from the district administration.

Table 3 demonstrates the percentage share of sub-sectors within the secondary and tertiary sectors. Within the secondary sector, manufacturing contributed 66.48% to 68.8% share, while construction's share ranged from 19% to 22%. The average annual growth rate is observed highest in manufacturing (7.85%), followed by electricity gas and water supply (6.59%) and construction (5.44%).

Within the tertiary sector, trade, hotels, and restaurants constituted the highest share (27.03%) in 2016-17, followed by other services (19.52%), public services (19.29%), and transport storage, and communication (18.52%). The average annual growth rate is observed highest (12.89%) in other services, distantly followed by financial services (8.51%), transport, storage and

communication (8.31%), public services (8.26), hotels and restaurants (8.03%). Overall, the district economy is driven by the growth of non-agriculture sectors as agriculture achieved negative growth.

Table 3: Trends in percentage share of non-agriculture sub-sectors in DGDP at Constant Prices (base 2011-12)

Year	Manufacturing	Electricity, gas, water supply	Construction	Secondary	Transport, storage, communication	Trade, repair, hotels and restaurant	Financial services	Real estate, & professional	Public administration	Other services	Tertiary
2011-12	66.48	12.29	21.23	100	18.47	27.30	7.31	8.99	21.92	16.01	100
2012-13	68.77	12.25	18.98	100	19.62	28.95	7.63	9.46	15.09	19.24	100
2013-14	66.19	11.47	22.33	100	18.42	27.49	7.31	8.08	18.95	19.76	100
2014-15	66.42	11.89	21.69	100	18.22	26.56	7.33	8.37	20.41	19.10	100
2015-16	68.06	11.79	20.14	100	18.51	26.91	7.54	8.32	20.23	18.49	100
2016-17	68.80	12.00	19.19	100	18.52	27.03	7.39	8.26	19.29	19.52	100
Average Growth Rate	7.85	6.59	5.44	7.07	8.31	8.03	8.51	6.56	8.26	12.89	8.32
Source: Estimated from statistical handbooks											

1.5 The Livelihood Status

Table 4 shows the livelihood status of the workforce in Uttarkashi district and Uttarakhand. In 2017, approximately 67% of workers were self-employed, while the corresponding figure for the state is 56.9%. The major difference is observed in the case of regular employment, which was much higher in Uttarakhand (24.2%) than in Uttarkashi district (17. 9%). Casualization of the workforce is higher in Uttarakhand (18.9%) than in Uttarkashi district (15.3%). Sectoral distribution of employment again reveals that in terms of workforce, the district economy is dominated by the primary sector as against 39.3 workers engaged in the primary sector in the state; the corresponding percentage in the district is 72.3.

Contrary to this, the secondary sector contributes only 11.5% to the total workers, while its share in the state is 25.4%. An almost similar pattern is observed in the case tertiary sector. Thus,

taking employment and GDP together, we can infer that the economic condition of workers in the primary sector is poorer in the district vis-à-vis other sectors as a whole.

Table 4: Livelihood Status in Uttarkashi (2017)

Employment Status			Sectoral distribution of employment			Distribution of workers by Skills		
Status	Uttarkashi	Uttara-khand	Sector	Uttarkashi	Uttara-khand	Skill	Uttarkashi	Uttara-khand
Self-employed	66.8	56.9	Primary	72.3	39.3	Low	22.2	24.9
Regular	17.9	24.2	Secondary	11.5	25.4	Medium	68.3	65.5
Casual	15.3	18.9	Tertiary	16.2	35.3	high	9.5	9.6
Total	100	100	Total	100	100	Total	100	100
Poverty status	9.9	15.6	Inequality (Gini Coeff.)	0.297	0.308			
Source: Uttarakhand Human Development Report								

The distribution of workers by their skills-set indicates that only 9.5% of workers in the district and 9.6% in the state come under the high skills category. The majority of them fall under the medium and low categories of skills. Poverty and inequality are also lower in the district than in the state, as depicted in the table.

Highlights-1

The primary sector plays a major role in the district economy, with almost 72% workforce engaged in it, although its contribution to the district GDP is less than 23%.

The crop sector recorded negative growth during 2011-2017, while livestock, forestry and Fishery achieved moderate positive GDP growth during the same period.

Mining & Quarrying recorded positive growth during the period, thus implying environmental sustainability of the ecologically sensitive district of the state.

Within the secondary sector, manufacturing recorded the highest average annual growth (7.85%), followed by electricity, gas and water supply (6.59%).

In the case of the tertiary sector, other services recorded the highest growth (19.81%), followed by financial services (12.89%).

Manufacturing contributes about 68% of the secondary sector's GDP and its share has increased marginally over the period.

Construction contributes slightly over 19% of the secondary sector's

2 QUANTITATIVE DATA ANALYSIS

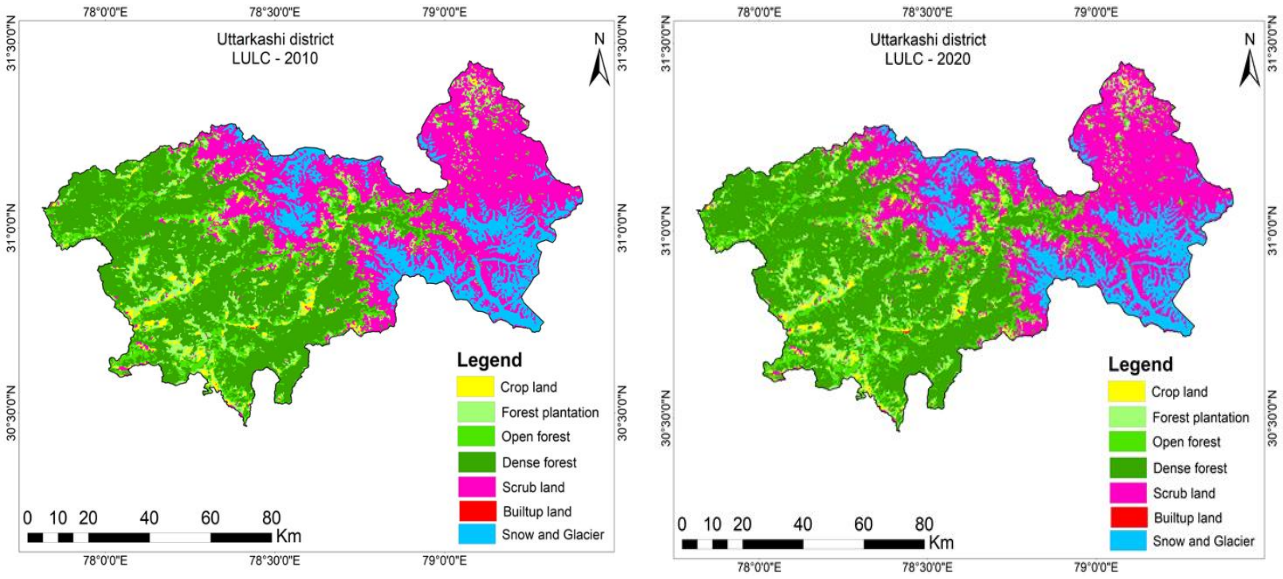
2.1 Agriculture and Allied Activities

2.1.1 Trend in Land Use and Land Cover

To understand the trends in land-use and land-cover, we analysis two types of data--GIS-based data and statistical data compiled from the District Statistical Handbooks of Uttarkashi. As per the GIS-based data (see Figure 1 and Table 5), between 2010 and 2020, the area under open forest and dense forest marginal increased from 919.81 km^2 to 960.38 km^2 and 2949.94 km^2 to 2970.65 km^2, respectively. However, cropland, forest plantation, and scrubland area marginally declined by 0.13%, 0.34% and 0.27%, respectively. Built-up and snow & glacier area remain constant between 2010 and 2020. It is clear from Table 5 that the changes in land use and land cover of Uttarkashi for 2010-2020 are not significant.

Table 5: Land use/ Land cover statistics classes of Uttarkashi district

LULC classes	Area(km^2) Year-2010	Area(km^2) Year-2020
Crop land	204.62	193.71
Forest plantation	576.20	547.9
Open forest	919.81	960.38
Dense forest	2949.94	2970.65
Scrub land	2655.44	2632.94
Built-up land	1.10	1.53
Snow and glacier	961.09	961.09
Total Geographical area	8268.20	8268.20



We notice some discrepancies when the GIS-based data are compared with the data compiled from the district statistical handbooks. The GIS-based map shows 8268.2 square kilometres geographical area of the district, while the handbook shows 8126.89 sq.km reported area of the district. Forest area constituted 88.88% of the total reported area and it remained constant during the period. The share of barren and uncultivable land has increased from 4.86% in 2009-10 to 4.97% in 2015-16. Areas under permanent pastures and under trees and gardens decreased in 2015-16. Net sown area has remained less than four percent during 2009-10 to 2015-16 (Table 6). Overall, the land-use pattern does not reveal any visible change during the last seven years, except the area under the current fallow.

Table 6: Trends in Land-use Pattern in Uttarkashi (as % of the total reported area)

Year	Total Reported Area (ha)	Area under forest	Cultivable wasteland	Current Fallow	Other Fallow	Barren and uncultivable land	Land other than agriculture	Pasture Land	Area under trees and gardens	Net Sown Area
1	2	3	4	5	6	7	8	9	10	11
2009-10	812689	88.80	0.36	0.13	0.32	4.86	0.67	0.65	0.56	3.65
2010-11	812689	88.80	0.36	0.10	0.28	4.86	0.67	0.65	0.56	3.73
2011-12	812689	88.80	0.36	0.15	0.34	4.86	0.68	0.65	0.56	3.61
2012-13	812689	88.80	0.29	0.16	0.34	4.97	0.73	0.56	0.55	3.60
2013-14	812689	88.80	0.29	0.23	0.35	4.97	0.73	0.56	0.28	3.52
2014-15	812689	88.80	0.29	0.24	0.35	4.97	0.73	0.56	0.55	3.51
2015-16	812689	88.80	0.29	0.07	0.43	4.97	0.73	0.56	0.55	3.72
Source: Prepared from District Statistical Handbook										

2.1.2 Trends in Operational Land Holdings

In Uttarkashi district, the total operational holdings has increased from 39536 in 2010-11 to 40605 in 2015-16, a net increase of 2.7 percent. Contrary to this, in the state, the number has declined from 912650 in 2010-11 to 881305 in 2015-16, a net decline of 3.43%. The majority of land holdings in the district are marginal and small. These categories of holding together constituted 90.1% in 2015-16, while the corresponding percentage in the state was 91.67% (Table 7).

Table 7: Distribution of Operational Holdings by Size-categories of Farms (in %)

	Agri, Census	**Marginal Holdings** (0-1 ha)	Small Holdings (1-2 ha)	Semi-Medium Holdings (2-4 ha)	Medium Holdings (4-10 ha)	Large Holdings (10 & above, ha)	Total Holdings (No.)
Uttarkashi	2010-11	70.81	17.41	9.65	2.08	0.04	39536
	2015-16	71.48	18.62	8.61	1.27	0.02	40605
							[2.7]
Uttarakhand	2010-11	73.65	17.24	7.1	1.9	0.12	912650
	2015-16	74.78	16.89	6.59	1.64	0.1	881305
							[-3.43]

Source: Compiled from Statistical Handbook 2018-19, UKUES. Figures in [ ] are percentage increase/decrease in 2015-16 over 2010-11.

2.1.3 Trends in Area, Production and Yield of Principal Crops

i. Trend in Cropping pattern

The agriculture of the district is dominated by food grains. Table 8 shows the trend in the area under principal crops during the last seven years. Rice, wheat and ragi together comprise the largest share in the gross cropped area (GCA). The area under these crops marginally increased from 63.4 percent in 2009-10 to 65.15 percent in 2017.18. Ragi is high nutritious cereal and is in high demand by the consumers. All cereals (rice, wheat, barley, maize, ragi and saava) have a little over 74 percent of the GCA of the district. Pulses consisted of about 10 percent share in the total cropped area. Overall, food grains shared over 86 percent of GCA in 2015-16. The share of oilseeds is only about four percent. In addition to food gains and oilseed, potato is another important crop.

Table 8: Trends in Cropping Pattern (as % GCA) and Cropping Intensity

Crop/Year	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Rice	23.23	23.17	25.20	23.89	22.74	24.52	25.45
Wheat	26.37	27.02	27.29	25.49	25.30	24.62	27.46
Barley	0.69	0.57	0.41	0.59	0.62	0.55	0.39
Maize	0.96	1.08	1.10	1.42	2.63	1.01	0.96
Raagi	12.59	13.21	12.78	13.39	11.47	13.04	12.24
Saava	5.13	5.46	4.61	0.59	5.58	5.71	4.69
Total Cereal	68.97	75.95	76.23	75.27	73.80	75.17	75.05
Urad	1.86	2.01	1.94	1.64	2.25	2.06	1.65
Masoor	0.76	0.55	0.58	0.50	0.60	0.69	0.74
Matar	1.23	1.20	0.82	1.97	1.79	1.87	1.93
Arhar	0.65	0.63	0.90	0.87	0.73	0.94	0.94
Total Pulses	4.51	10.90	10.60	10.46	12.92	12.38	11.30
Total Food Grains	73.48	86.85	86.83	85.74	86.71	87.54	86.34
Mustard	2.68	1.92	2.14	1.90	2.20	2.43	2.37
Net Til	1.65	1.84	1.60	1.08	1.48	1.32	1.54
Soyabean	0.11	0.47	0.98	1.46	0.44	0.43	0.47
Total Oilseeds	4.44	4.23	4.73	5.03	4.09	4.19	4.43
Potato	6.54	6.24	6.01	7.45	6.35	5.46	5.93
Net Sown Area (% of GCA)	66.63	67.55	69.58	70.50	72.24	70.46	71.72
Gross Sown Area (ha)	44554	44881	42145	41524	39615	40454	42182
Cropping Intensity	66.63	67.55	69.58	70.50	72.24	70.46	71.72
Source: Estimated from District Statistical Handbooks							

ii. Trends in Per Hectare Yield of Principal Crops

Crop yields in the district are relatively low. The per hectare yield of rice was as low as 13.65 qtls/ha in 2009-10 and as high as 19.67 qtls/ha in 2012-13. Similarly yield of wheat ranges between 13.69 to 19.54 qtls/ha during 2009-10 to 2015-16. A more or less similar pattern is also observed in the case of barley. Table 9 depicts that maize yield has improved in recent years. **It is significant to note that the average productivity of ragi has been higher than that of rice and wheat. Relatively being a high-value crop, it can raise the farmers' income if proper marketing support is provided to the farmers**. **Another high nutrition and value crop is saava, which also has a higher yield than rice and wheat**, as shown in Table 9. Marketing support and R&D intensification can make these crops more remunerative for farmers.

Among pulses, per hectare yield is higher in urad than other crops. Urad constituted 1.86 percent of GCA and has the potential to raise farmers' income. Among oilseeds, mustard is an important crop. Its yield ranges between 1.9 to 2.68 qtls/ha. Since per quintal prices of mustard are higher than rice and wheat, its cultivation can provide a better return to the farmers. Potato is another high-value crop in the district. Its yield ranges between 5.46 to 7.45 qtsl/ha. **Thus, ragi, saava, urad, mustard, and potato are promising crops for farmers of the district.**

Table 9: Trends in per hectare productivity of main crops (in quintals)

Crop/Year	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Rice	13.65	16.48	16.16	19.67	17.89	16.63	17.67

Wheat	13.98	16.90	16.44	19.54	17.80	13.69	16.24
Barley	11.05	13.81	14.14	18.98	15.14	12.30	13.85
Maize	12.52	1.32	12.49	11.24	10.36	25.95	25.96
Raggi	15.49	18.35	18.54	19.08	16.88	17.50	18.39
Saava	11.46	15.89	18.33	143.05	14.08	14.79	15.37
Total Cereal	13.91	16.86	16.77	20.43	16.32	14.91	16.62
Urad	6.57	6.45	10.31	15.51	11.75	8.14	7.42
Masoor	5.91	12.17	7.15	6.55	9.75	8.42	8.98
Matar	7.01	6.81	6.77	6.59	6.61	6.61	6.59
Arhar	8.01	7.78	8.21	10.03	8.76	7.35	6.03
Total Pulses	6.78	7.46	51.80	10.13	11.72	8.64	7.25
Total Food Grains	13.47	16.31	18.72	19.70	14.81	14.03	15.50
Mustard	3.50	5.70	5.50	6.87	5.00	7.53	6.98
Net Til	2.20	2.26	2.51	4.83	2.96	2.96	4.56
Soybean	10.00	10.19	10.19	2.26	9.77	9.84	9.13
Total Oilseeds	3.17	4.71	5.46	4.86	4.69	6.33	5.83
Potato	114.21	105.05	70.93	77.01	89.36	88.51	78.48
Source: Estimated from District Statistical Handbooks							

iii Trends in Production of Principal Crops

Table 10 depicts that wheat consisted of high production among the individual cereal crops between the period 2009-10 to 20013-14 but from last 2-year rice have high production. The rice has the highest production (18978 tons), followed by wheat (18809 tons) and ragi (9494 tons) in 2015-16. These three crops had 89.85 percent share in the total cereal production in 2015-16.

Table 10: Trends in Production of Principal Crops (in metric tonnes)

Crop/Year	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Rice	14134	17132	17165	19506	15981	16499	18978
Wheat	16429	20489	18907	20695	17874	13643	18809
Barley	338	355	246	467	371	272	166
Maize	537	595	577	661	1078	1064	1051
Raagi	8686	10877	9990	10603	7734	9233	9494
Saava	2619	3893	3561	3519	1088	3415	3039
Total Cereal	42743	54790	51687	56890	47360	45360	52620
Urad	545	851	851	1058	1047	680	518
Masoor	201	303	178	135	230	236	280
Matar	383	367	228	540	468	499	538
Arhar	283	221	312	361	254	279	239
Total Pulses	1363	4764	3732	4886	4653	4329	3846
Total Food Grains	44106	59554	55419	61776	52013	49689	56466
Mustard	418	491	497	543	437	742	697
Net Til	162	187	169	217	174	157	195
Soybean	48	216	422	137	141	169	182
Total Oilseeds	628	894	1088	904	761	1072	1094
Potato	33291	29403	17980	23836	22218	19536	19637

Source: Estimated from District Statistical Handbooks

Urad and matar had the highest share in the total pulses production. Among oilseed production, mustard is the main crop that comprised about 64 percent share in the total oilseed production in 2015-16. Potato is another important crop. Its production was highest (33291 tons) in 2009-10 and lowest in 2011-12 (17980 tons).

We have calculated crop-wise average, standard deviation (SD) and coefficient of variation(COV) in the area, production and yield to understand variability across years. In the case of area under different crops, the lowest variability is observed in total cereals (4.86%), followed by total food grains (5.45%), and rice (5.80%). It is observed highest in saava (39.58), followed by matar (27.18%) and total pulses (24.67%). Overall, the area under pulses has more variability than the area under cereals and oilseeds (Table11).

Table 11: Variability in Area, Production and Yield of Principal Crops in Uttarkashi (2009-10 to 2015-16)

Crop/Year	Area (1000 ha)			Production (1000 Tons)			Yield (Qtl. / Ha)		
	Average	SD	COV	Average	SD	COV	Average	SD	COV
Rice	10.14	0.59	5.80	17.06	1.81	10.63	16.88	1.85	10.98
Wheat	11.08	0.87	7.90	18.12	2.46	13.57	16.37	2.05	12.54
Raagi	5.35	0.44	8.14	9.52	1.10	11.51	17.75	1.23	6.94
Saava	1.92	0.76	39.58	3.02	0.94	31.29	33.28	48.45	145.57
Total Cereal	31.36	1.52	4.86	50.21	5.18	10.32	16.55	2.04	12.32
Urad	0.81	0.09	10.70	0.79	0.22	27.79	22.88	36.06	157.61
Matar	0.65	0.18	27.18	0.43	0.11	26.22	6.71	0.16	2.37
Total Pulses	4.37	1.08	24.67	3.94	1.22	30.97	14.83	16.40	110.61
Total Food Grains	35.73	1.95	5.45	54.15	6.05	11.18	16.08	2.35	14.61
Mustard	0.94	0.13	13.98	0.55	0.13	23.02	5.87	1.39	23.62
Pure Til	0.64	0.13	19.91	0.18	0.02	11.67	3.18	1.08	33.89
Total Oilseeds	1.88	0.17	8.88	0.92	0.18	19.50	5.01	1.02	20.33
Potato	2.65	0.30	11.31	23.70	5.68	23.95	89.08	15.68	17.60

Source: Compiled from District Statistical Handbooks

Overall, variability in the production of different crops is higher than in the area under these crops. Saava has the highest COV in production (31.29%), followed by total pulses (30.97%), urad (27.79%), mater (26.22%), potato (23.70%) and mustard (23.02%). Variability in production depends on the variability in area under the crop and variability in the yield. In most crops, variability in yield is higher than that in the area. Several factors, such as market prices and rainfall patterns, affect agricultural production variability.

2.1.4 Consumption of Chemical Fertilizers

It is significant to note that per hectare use of chemical fertilizers is almost negligible. Table 12 shows that nitrogen use ranges between 0.37 kgs/ha to 0.55 kgs/ha of GCA. Phosphorous use ranges between 0.43 khs/ha to 0.74 kg/ha of GCA. The use of potassium is almost zero. Total fertilizers use ranges from 0.96 to 1.58 kh/ha of GCA (Table 12). It can be inferred from the

fertilizers consumption data that the district's agriculture is chemical-free, and farmers have a natural advantage to do organic farming.

Table 12: Trends in Use of Chemical Fertilizers in Agriculture (Kgs/per ha GCA)

Fertilizer/Year	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Nitrogen	0.55	0.51	0.42	0.37	0.46	0.46
Phosphorous	0.74	0.67	0.48	0.43	0.59	0.51
Potasium	0.29	0.33	0.17	0.16	0.12	0.07
Total	1.58	1.50	1.07	0.96	1.16	1.04
Source: Compiled from District Statistical Handbook						

2.3.4 Irrigation Structure and Status

Table 13 shows that there has been little progress in the addition of canals during the last five years. The length ranges between 583.86 to 662.49 kilometers. The number of government tube wells varies from 4 to 6, whereas the groundwater pump set varies from 22 to 140. The number of water tanks has decreased from 2368 in 2010-11 to 248 in 2016-17, a net decrease of 2120 tanks. Length of *Gool* has decreased from 2576.48 Kms in 2010-11 to 733.66 Kms, a net decrease of 1842.82 kms during the period. The number of high drums is constant throughout the year (2016-17).

Agriculture in the district is mostly under rain-fed conditions. The net cultivated area under irrigation ranges between 14.26 to 18.82 percent. There is not much progress in bringing more area under irrigation. Gross irrigated areas as a percentage of GCA are also relatively low (16.87-23.86%).

Table 13: Types of Irrigation Systems and percentage of the net and gross Irrigated Area

Name/Year	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Length of Canal (KM)	583.86	591.47	610.36	610.36	619.825	691.842	662.497
No. of Govt. Tube wells	-	-	4	2	4	2	6
No. of Ground level Pump set	25	131	22	140	140	28	28
No. of bore-well Pump set	-	-	-	-	4	4	4
No. of Tanks	2368	2463	160	124	159	187	248
Gool in KM	2576.483	2658.545	112.629	227.703	309.521	337.371	733.663
High drums	111	111	111	111	111	111	111
% Of NIA	14.26	16.09	18.82	15.00	17.02	15.94	-
% Of GIA	16.87	20.30	23.86	19.17	20.27	20.96	-
Source: Compiled from District Statistical Handbook							

2.1.4 Out-Migration and Agriculture

Due to lop-sided development in the state during the post-statehood period, the intensity of out-migration has increased (Mamgain & Reddy, 2015). Moreover, the nature of out-migration has been gradually changing from seasonal or temporary to permanent, having far-reaching consequences for the rural economy. The departure makes it difficult for the remaining people to do farming as cultivated land intersperses with inactive uncultivated land. There is a vicious cycle

between out-migration and agriculture. Since agriculture is not remunerative and able to generate gainful employment (see table above), the youths out-migrate in search of better livelihood options. This leads to the abandonment of agriculture to a greater extent.

Tourism is a key growth driver of the district economy. It can be integrated with the promotion of high-value crops (HVCs) such as vegetables, fruits, mushrooms, flowers and medicinal crops. If HVCs are promoted, hotels and dhabas, driven mainly by tourists, may get fresh vegetables, fruits, and other food items from the local farmers. Tourists need different kinds of agro-products and handicrafts, which the local market can supply. Diversifying agriculture and allied activities toward low volume and high-value agro-products would check out-migration and work as a multiplier in the local economy, generating additional employment avenues in the non-farm activities. There are three deterrents—out-migration, the menace of wild animals and interspersing of cultivated landholding with inactive and abandoned landholding. The possibility of evolving an economically viable model of convergence of MGNREGA activities with the concerned line departments would be explored to promote HVCs and improve people's livelihood. Uttarakhand Human Development Report (2018) shows that about two-thirds of total first-time migrants in Uttarkashi migrated alone and about 19 percent with family members (Table 14).

Table 14: Process of Migration (First Migration) in Uttarkashi (in %), 2017

	Migrated alone	Migrated with family members	Migrated with members of community/ Village	With quittances/Friends (other than col 4)	Middle men/ contractors	Any other	Total
1	2	3	4	5	6	7	8
Uttarkashi	65.9	18.8	8.8	5.3	0.4	0.8	100
UK	72.1	18.0	6.6	2.6	0.1	0.6	100
Source: Uttarkhand Human Development Report							

2.1.5 Status of Organic Farming

To promote sustainable agricultural practices and improve the farmers' livelihood, the Government of India launched PKVY and Namami Gange schemes. Under these schemes, farmers are incentivized to form groups to do organic farming and sell their products with PGS certification. The state set up the Uttarakhand Organic Commodity Board (UOCB) in 2003 as a nodal agency to facilitate organic clusters and provide technical support to promote organic farming. The area under organic farming in the state was about 18% of the NSA in 2019 (https://www.downtoearth.org.in/blog/agriculture/how-indian-states-are-promoting-organic-natural-farming-73306). Uttarakhand is the first state of India which enacted Organic Farming Act in 2020 and declared 10 of its blocks fully organic. The Uttarkashi district has the natural advantage of organic farming as per hectare use of chemical fertilizers.

Table 15 shows the status of organic farming PGS groups constituted under PKVY and Namami Gange schemes. On June 30, 2021, there were 709 organic farming groups with 34583 registered farmers in the district. Out of these groups, about 100% constituted under the PKVY. Block-wise data show that under PKVY, the highest number of groups and number of farmers are

in Bhatwari (154 and 7670), followed by Chinyalisaur (136 and 6772) and Dunda (139 and 6406) and lowest in Purola (75 and 3632).

Table 15: Status of Organic Farming PGS Groups under PKVY and Namami Gange Schemes in Uttarkashi (as on June 30, 2021)

S.No.	Block	Scheme	No. of groups	No. of farmers in groups			
				Total	Average	Median	SD
1	Bhatwari	PKVY	154	7670	49.8	50	16
		Namami Gange	-	-	-	-	-
2	Chinyalisaur	PKVY	136	6772	49.79	50	21.67
		Namami Gange	-	-	-	-	-
3	Dunda	PKVY	139	6406	46.08	50	13.77
		Namami Gange	-	-	-	-	-
4	Mori	PKVY	77	3810	49.48	50	4.91
		Namami Gange	-	-	-	-	-
5	Naugaon	PKVY	128	6293	49.16	50	4.75
		Namami Gange	-	-	-	-	-
6	Purola	PKVY	75	3632	48.42	50	7.61
		Namami Gange	-	-	-	-	-
7	Total Uttarkashi District	PKVY	709	34583	48.77	50	14.01
		Namami Gange	-	-	-	-	-
		Total	709	34583	48.77	50	14.01
Source: Compiled from https://pgsindia-ncof.gov.in/							

Since economies of scale in both production and marketing matter in organic farming, possibilities of some institutional framework may be in the forms of SHGs/ farm cooperative/PFOs/contract farming, etc. be designed. Organic farming could be an economically viable option in the district if the government builds strong marketing networks linking farmers, processors, and distributors with the easy certification process and minimizes farmers' risk by protecting their farm income through payments of ecosystem services. Organic farming Act is a good initiative and its provisions should be effectively enforced. A long-term system of incentive as well as regulation may be evolved to retain the existing farmers and motivate others to move towards the sustainable farming system in the district.

The major problem for the growth of organic farming are:

1. Lack of awareness and knowledge about the use of bio-fertilizers and bio-pesticides and other supplementary nutrients required to enrich the soil productivity.
2. Shortage of biomass and its incapability in fulfilling all soil nutrients.
3. Although efforts are being made to integrate the farmers with the market network, farmers still have inadequate access to the marketing and distribution network.

Highlights-2

The area under forest is about 88.8% of the total reported area. Forest-based livelihood activities have the potential for income generation in the district.

Marginal and small farmers constituted about 90.1% of the total farmers of the district.

The agriculture of the district is dominated by food grains which comprise 75.05% of the GCA. Three cereals crops-wheat, rice and ragi together constituted 65.15% of the GCA.

Ragi, saava, urad, mustard and potato are promising crops in the district. Marketing support and R&D intensification can make these crops more remunerative for farmers.

Variability in the yield of different crops is higher than in the area under these crops. Variability in production depends on the variability in area and variability yield. In most crops, variability production is due to higher variability in yields.

Per hectare use of chemical fertilizers is almost negligible. Agriculture in the district is almost chemical-free and farmers have a natural advantage to do organic farming.

Agriculture is mostly under rain-fed conditions. Net irrigated area is about 6%.

2.2 Trends in Livestock

Livestock has an important place in the rural economy, particularly in the hill regions where farm mechanization has limited scope due to sloppy terrain. Data on livestock come from the livestock census, which is conducted periodically. Table16 shows that the total number of cattle (cows and bulls) has increased from 106827 (2003) to 111450 (2012) and then declined to 105479 in 2019. During 1998 and 2019, there has not been much change in male cattle, but the number of exotic female cattle has drastically increased, probably due to increased demand for livestock products. Similarly, the trend of Buffalo is showing a decreasing trend. The number of Buffalo has decreased from 38690 in 2003 to 25945 in 2019 for both females and males. The number of sheep shows ups

and downs during the entire period. It was highest in 2003 (101268) and then lowest in 2019 (80349). In the case of goats, the trend is showing an increase from 2003 (95593) to 2012 (120998) then decreased in 2019 (100982). The number of pigs in the district is relatively low. The number of poultry has increased from 2003 (39429) to 2012 (27359).

Table 16: Trends in Livestock population (in numbers) during 1998-2019

	Category	2003	2007	2012	2019
Indigenous Cattle	Total Male	54737	57097	52289	42545
	Total Female	40971	39623	36893	40446
	Total	95708	96720	89182	82991
Exotic Cattle	Total Male	4239	4312	7281	2359
	Total Female	6880	9570	14987	20129
	Total	11119	13882	22268	22488
Total Cattle		106827	110602	111450	105479
Buffalo	Total Male	6642	6354	5430	732
	Total Female	32048	31688	25599	25213
	Total	38690	38042	31029	25945
Sheep	Total Indigenous Sheep	48137	32930	29485	31606
	Total Exotic Sheep	53131	56794	64431	48743
	Total Sheep	101268	89724	93916	80349
Goat	Total Male	-	-	-	15548
	Total Female	-	-	-	85434
	Total	95593	100451	120998	100982
Pig	Total Indigenous Pig	325	125	195	151
	Total Exotic Pig	155	109	73	118
	Total Pig	480	234	268	269
Total Livestock		356147	347563	365718	-
Total Poultry		39429	33593	27359	-
Source: Compiled from District Statistical Handbook and http://dahd.nic.in/animal-husbandry-statistics					

Table 17 shows animal hospitals and development centres in the district. The number of cattle hospitals remained the same over the period, but cattle development centres increased from 34 in 2010-11) to 43 in 2016-17). The number of man-made reproduction centres shows ups and downs during the period. There has not been any change in the number of cattle reproduction centre and sheep development centres.

Table 17: Year-wise number of Cattle Hospitals and Development Centres

Category	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Cattle Hospital	25	25	25	25	25	25	25
Cattle Development Centre	34	34	34	34	39	43	43
Man-Made Reproduction Centre	37	39	23	23	42	42	42
Man-Made sub-Centre	-	-	19	19	-	-	-
Cattle Reproduction Farm	2	2	2	2	2	2	2
Sheep Development Centre	25	25	25	25	25	25	25
Source: Compiled from District Statistical Handbook							

2.3 Trends in Horticulture Crops

The district has a high potential for horticulture development. With policy support and a well-designed action plan, this sector can be the growth driver for the agriculture sector. Table 18 shows the percentage share of major fruit crops in the total cropped under fruits. In 2016-17, apple constituted the highest share (59.13%), followed by pear (10.7%) and walnut (9.47%). The total area under fruits shows high variation from 1334 ha (in 2013-14) to 15285 ha (2016-17).

Table 18: Trends in percentage share of principal fruit crops in total area under fruits

Crop/Year	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Apple	57.56	52.26	57.64	68.22	58.18	59.21	59.13
Pear	10.87	9.90	10.95	7.65	10.79	10.67	10.70
Peach	1.66	1.78	2.07	5.92	2.17	2.12	2.11
Plum	5.34	4.71	5.20	2.17	5.04	4.89	4.83
Apricot	1.08	0.98	1.07	3.52	1.06	1.03	1.01
Walnut	10.27	9.12	10.07	5.25	9.88	9.59	9.47
Lemon	2.15	1.94	2.19	1.80	2.15	2.08	2.12
Mango	1.58	1.43	1.59	1.65	1.53	1.49	1.47
Other Fruits	9.49	8.38	9.29	3.60	9.04	8.77	8.94
Total fruits (ha)	13401 (100)	15179 (100)	13865 (100)	1334 (100)	14353 (100)	15092 (100)	15285 (100)
Source: Compiled from District Statistical Handbooks							

Production of apples ranges from 3753 tons in 2012-13 to 45203 tons in 2010-11. Its production has steeply declined in recent years. Production of almost all fruits massively declined in 2016-17 compared to 2010-11. Total production of fruits has dropped from 66834 tons in 2010-11 to 39530 tons in 2018-19 (Table 19).

Table 19: Year-wise production of fruit crops in Uttarkashi District (in tons)

Crop/Year	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Apple	23406	23406	29713	3838	21773	3354	3357	3358	2891
Pear	7635	7898	8896	845	6861	2929	2930	2930	1367
Peach	5774	6007	6930	1339	5214	1349	1350	1350	1169
Plum	2282	2288	2423	286	1563	301	30	302	313
Apricot	285	2913	3205	412	2035	428	430	428	393
Walnut	5287	5308	5399	967	5111	984	984	984	931
Lemon	42118	42200	44878	4368	42305	3865	3866	3866	3762
Mango	5418	5446	5775	480	5438	486	487	487	485
Other Fruits	4990	5186	5893	9953	5310	1515	1517	1517	1517
Total	97195	100652	113112	22489	95610	15212	15222	15221	12828

Source: Compiled from District Statistical Handbooks
Note: Data on horticulture show discrepancies in the official records.

Table 20 shows that the per hectare yield of almost all crops has declined during 2010-11 and 2016-17. The productivity of apple decelerated from 5.86 tons in 2010-11 to 2.86 tons in 2016-17. The productivity of all crops (peach, plum, apricot, walnut, lemon, and mango) was highest in 2013-14. The production per hectare yields all fruits are showing ups and downs during the period. Per hectare, yields of all fruits are declined from 2010-11 to 2018-19. The above analysis indicates the dismal scenario of fruits production in the district. The reasons for this dismal condition of horticulture in the district need to be explored.

Table 20: Per hectare yield of principal fruits in Uttarkashi District (tons/ha)

Crop/Year	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Apple	45203	32900	3753	6918	18251	19529	25850
Pear	10075	8300	801	2484	3111	3235	6164
Peach	1298	1050	272	1793	1301	1340	891
Plum	3980	3680	325	1181	809	825	2585
Apricot	1232	1040	851	2095	857	874	752
Walnut	1008	950	361	415	854	871	680
Lemon	948	948	606	741	783	800	717
Mango	520	520	283	178	352	359	371
Other Fruits	2570	2020	2297	812	2515	2566	1482
Total fruits	66834	16905	9553	16621	28841	30406	39530
Source: Compiled from District Statistical Handbooks							

Area, production, and yield of almost all fruits evince a magnitude of variability indicated by COV values. In the case of area, the highest COV is in plum, closely followed by walnut, pear, lemon, apple, mango, peach, and apricot. Likewise, COV in production is the highest plum, followed by pear, apple, apricot, peach, walnut, mango. In yield, the highest variability is observed in plum, followed by lemon and walnut. A perusal of Table 21 reveals that the variability in yield is higher than production and area. The high variability in production is more due to variability in yield than due to the variability in area.

Table 21: Variability in Area, Production and Yield of Principal Crops (2009-10 to 2017-18)

Crop/Year	Area (ha)			Production (tons)			Yield (tons/ha)		
	Av	SD	COV	Av	SD	COV	Av	SD	COV
Apple	7267.71	2637.03	36.28	21772.0	12511.14	57.46	3.62	2.26	62.52
Pear	1339.00	508.19	37.95	4881.43	2927.19	59.97	6.44	7.59	117.79
Peach	258.71	80.24	31.01	1135.0	409.37	36.07	6.36	6.81	107.13
Plum	625.71	243.77	38.96	1912.14	1289.69	67.45	8.23	13.40	162.75
Apricot	135.71	36.39	26.81	1100.14	403.78	36.70	11.71	13.46	114.95
Walnut	1219.86	470.17	38.54	734.14	223.25	30.41	1.33	1.88	142.17
Lemon	265.14	99.06	37.36	791.86	107.03	13.52	6.67	9.89	148.33
Mango	191.57	69.35	36.20	369.00	105.99	28.72	2.72	2.23	81.77

Litchi	18.67	0.47	2.53	14.36	13.89	96.67	0.76	0.73	95.71
Other Fruits	1124.14	440.42	39.18	2037.43	577.60	28.35	3.90	5.32	136.67
Total fruits	12644.14	4664.37	36.89	29812.86	16648.51	55.84	3.69	3.80	102.86
Source: Compiled from District Statistical Handbooks									

2.4 Trends in Area, Production and Yield of Vegetable Crops

Table 22 shows the trends in the area, production, and per hectare yield of total vegetable crops. It is evident from the table that the area under potato is gradually increasing from 1706 (2010-11) to 4731 (2013-14) and then decreasing to 3355 (2016-17). The production of potatoes varies from 22779 in 2014-15 to 30874 in 2013-14 and shows ups and downs trends during the period (2010-2017). However, the yield of potatoes has increased from 0.65 (2010-11) to 8.49 (2016-17). Likewise, the area and production of other vegetables are showing ups and downs trends during the period. The yield of other vegetables has increased from 0.048 in 2010-11 to 4.88 in 2016-17.

Table 22: Area, Production and Yield of Vegetables (area in ha, and production and yield in tons)

Crop/Year		2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Potato	Area	1706	1960	2148	4731	4544	3559	3355
	Production	26094	30426	25777	30874	22779	27927	28491
	Yield	0.65	0.65	0.83	0.15	0.2	7.85	8.49
Total Vegetables	Area	3059	3277	2970	7340	8766	6301	7379
	Production	38594	42239	36423	31885	34527	37371	36026
	Yield	0.048	0.048	0.82	0.23	0.25	5.93	4.88
Source: Compiled from District Statistical Handbooks								

Overall, the state of horticulture in the district is in dismal condition. Agriculture and allied sectors can improve rural livelihood by diversifying areas such as horticulture, aromatic and medicinal plants, animal husbandry, including dairy, fisheries, sericulture, bee-keeping, mushroom production, etc. Fruits, vegetables, potatoes, mushrooms, spices, medicinal plants, and flowers can provide remunerative returns to farmers as their demand is income-elastic. It is significant to note that the state government has initiated the consolidation of land holdings in the hilly region. It would help the farmers to bring their scattered holdings to one place, which, in turn, may attract more investment in agriculture.

Highlights-3

Livestock has an important place in the rural economy. Its contribution to agriculture has been gradually rising.

The district has a high potential for horticulture development. With policy support and a well-designed action plan, this sector can be the growth driver for the agriculture sector.

In 2018-19, the area under the apple crop constituted the highest share (29.71%), followed by lemon (19.19%) and walnut (14.64%). The total area under fruits shows high variation across years mainly due to steep decline in the share of area under lemon crop.

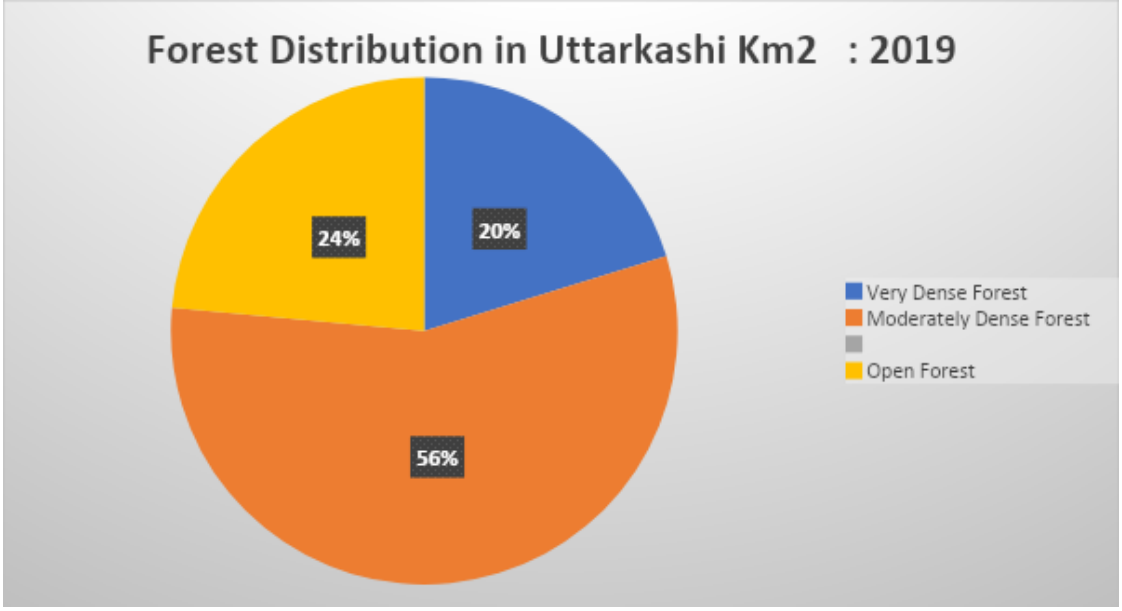
On average, the production, as well as yield of most of the fruit crops, have declined over the period.

The variability in production is driven more by variability in yield than the variability in the area in most of the fruits.

Fruits, vegetables, potatoes, mushrooms, spices, medicinal plants, and flowers can provide remunerative returns to farmers

Forestry

Total geographic area of the district is 8016 Km^2. As per 2019 Forest survey of India assessment, district has total 37.87% of forest area of total geographic area. The total forest cover in the district is 3036 Km^2. From this total area, 614.67 Km^2 comes under very dense forest (VDF) category, 1706.86 Km^2 is moderately dense forest (MDF), and 714.47 Km^2 area is open forest (OF) (FSI, 2019).



Forest Survey of India 2019 Uttarakhand vs Uttarkashi Comparative Assessment						
Area	Geographical Area	Very Dense Forest	Moderately Dense Forest	Open Forest	Total	%of Geographical Area
Uttarkashi	8016	614.67	1706.86	714.47	3036	37.87%
Uttarakhand	53483	5046.76	12805.24	6451.04	24303.04	45.44%

2.3.1. Biodiversity:

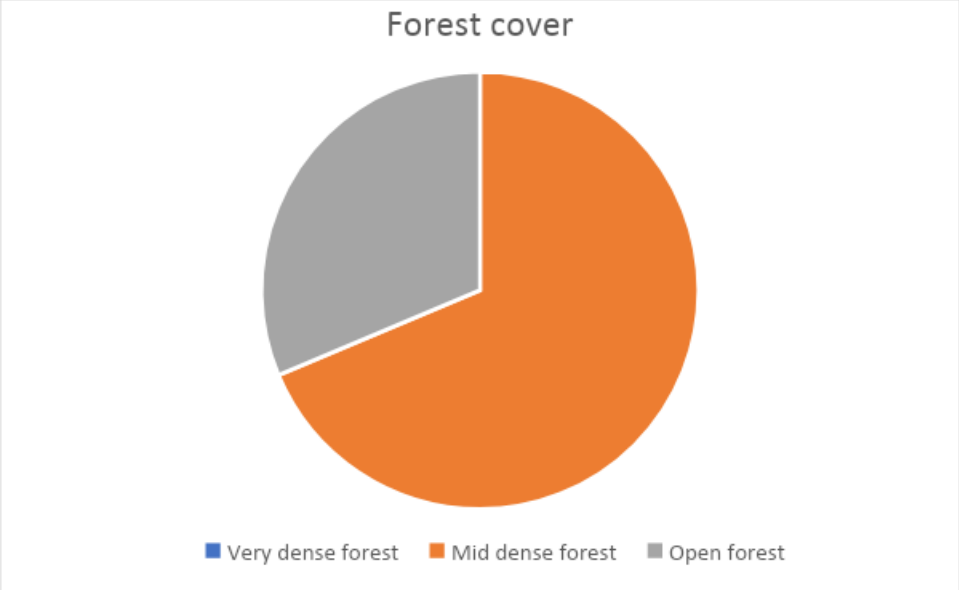
The district's biodiversity data includes crop production, livestock population, bird species, and forest cover. Umbrella project biodiversity of Uttarakhand reports the biodiversity data of the Uttarkashi district. As per the data, 611 flora and fauna have been observed till now. A total of 332 species are present in the district, in which 39.46% are insect, 39.76% plant species, 0.9% amphibian, 2.41% mammal species, 6.63% birds, and 2.71% reptiles.

Table 1 Bird species recorded in the district.

Number of species	556
Number of rare/accidental species	4
https://avibase.bsceoc.org/checklist.jsp?lang=EN&p2=1&list=clements&synlang=&region=INwhukut&version=text&lifelist=&highlight=0	

Forest cover (in sq. km.)

Geographical area	Very dense forest	Mid dense forest	Open forest	Total	% of Geographical area `	Change with respect to 2017 assessment	Scrub
8016	614.67	1706.86	714.47	3036.00	37.87	8.00	21.00



2.4 Tourism

2.5 Wetlands

The district is not comprised of many wetlands. The district consists of areas like dodital (a freshwater lake), one of the large size water bodies present in the district. Table 1 represents the number of wetlands and their area representation in the district.

Table 1: Wetland Data of Uttarkashi District

Wetland Types	Total Number of												
	Wetlands:			Area (ha)									Aquatic Vegetation
Natural Wetlands	NRCD	NWIA	Diff.	<2.25	<5	<10	<20	<50	<200	<500	<1000	>1000	
Lake/ponds	0	0	0	0	0	0	0	0	0	0	0	0	0
Ox-bow lakes/cut off meanders	0	0	0	0	0	0	0	0	0	0	0	0	0
High altitude Wetlands	3	3	0	0	2	1	0	0	0	0	0	0	0
Riverine Wetlands	0	0	0	0	0	0	0	0	0	0	0	0	0
Waterlogged	0	0	0	0	0	0	0	0	0	0	0	0	0
River/Stream	0	12	12	0	0	0	0	0	0	0	0	0	0
Man-made Wetlands	NRCD	NWIA	Diff.	<2.25	<5	<10	<20	<50	<200	<500	<1000	>1000	AV
Reservoirs/Barrages	0	0	0	0	0	0	0	0	0	0	0	0	0

Tanks/ponds	0	0	0	0	0	0	0	0	0	0	0	0	0
Waterlogged	0	0	0	0	0	0	0	0	0	0	0	0	0
Salt pans	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (58)	3	15	12	43	2	1	0	0	0	0	0	0	0

Source: (National River Conservation Directorate, 2008), (Space Application Centre-ISRO, 2007)

- The district comprises 58 wetlands; most of them are rivers/streams.
- Maximum wetlands available in the district are natural.
- The size of the wetlands is generally less than 10 ha
- No wetland has aquatic vegetation.

2.6 Energy

2.6.1. Solar Energy

In Uttarakhand, operation and execution of various schemes based on non-conventional energy resources is handled by Uttarakhand Renewable Energy Development Agency (UREDA) through-local panchayats, volunteer organizations and district administrations.

The graph represented by Fig. 1 represents the percentage of households using different sources for lightning. This data is according to the 2011 census. It is very clear that majority of households in the district, approximately 80% use electricity as the main source of lightning. 17.80% use kerosene and only 2.54% use solar as the main source of lightning.

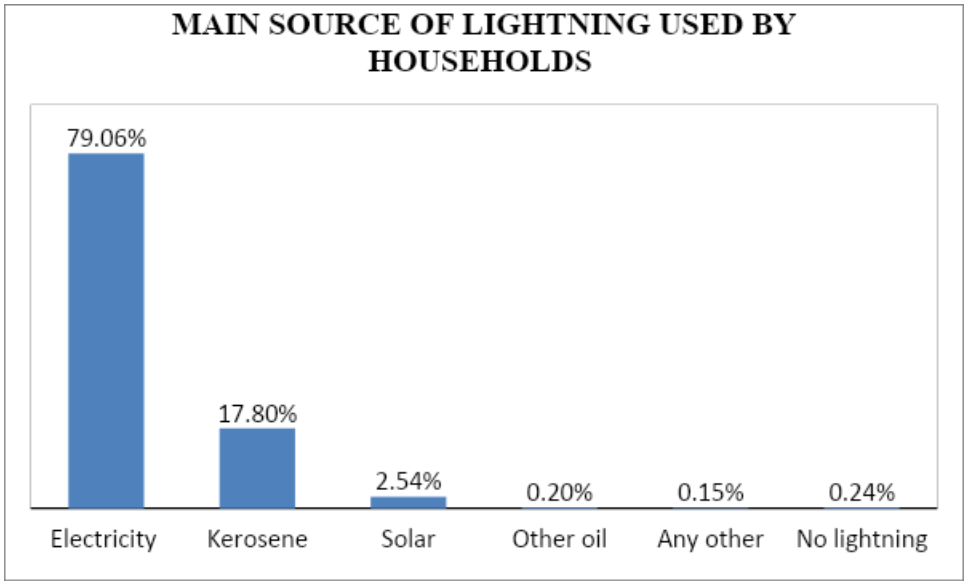


Fig. 1

The data on the district website gives an account on the installed units utilizing solar energy in form of solar photovoltaic and solar thermal. Under the Solar thermal scheme the state Uttarakhand

provides different programs such as Solar water heating systems, Solar cooking systems, Solar Steam cooking system and Parabolic concentrator solar water heating systems. Under Solar energy schemes there are mainly two of them one is the Mukhyamantri Saur Swarozgar Yojana and the other National Solar Policy, phase-II.
In the district Uttarkashi 404 Dish solar cookers under Mid Day Meal and Market Mode Programme upto 2015-2016 have been installed.

2.6.2.Biomass Energy

In Uttarakhand, operation and execution of various schemes based on non-conventional energy resources is handled by Uttarakhand Renewable Energy Development Agency (UREDA) through local panchayats, volunteer organizations and district administrations.

The district Uttarkashi depends on agriculture for its economy and livelihood. The net sown area of the district is 30800ha and the gross sown area is 47500 ha which accounts to cropping intensity of 170%. The cropping intensity of the district is quite good. Table 1 gives an account of major crops and their productivity in the district.

CROP	PRODUCTIVITY (kg/ha)
Paddy	1595
Wheat	1172.4
Finger millet	1595.4
Barnyard millet	1467.8
Maize	1186.6
Apple	6200.71
Pear	7321.17
Plum	5662.40
Potato	18288
Cabbage	17000

Table 1

Uttarkashi has 37.87% are of the total geographical area under forests which accounts to 3036.00 sq. km. The dense forests are spread over the area of 416.7 sq. km., moderately dense over an area of 1706.86 sq. km. open forests over 714.47 sq. km. Between the altitude of 1000-2000 m, the forest cover is almost exclusively of pine.

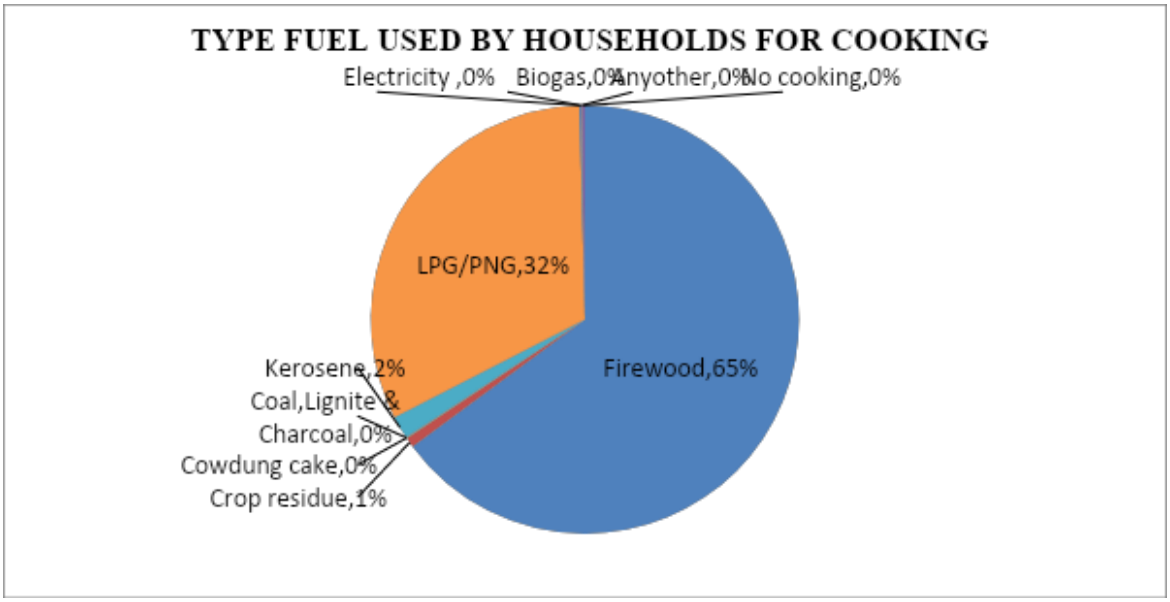


Fig. 1

According to the data from 2011 census, 65% households use firewood and 32% use LPG/PNG. Very few people use crop residue and kerosene. The drawback is that although only 1-3% households use kerosene or crop residue which is good, but majority of them use firewood (Fig. 1).

The district does not have any biomass energy plant from any of the available resources.

2.6.3.Biogas Energy

Five family-sized biogas plants have been installed in the district between the years 2009 to 2019. Biogas potential has been evaluated by average livestock and agricultural waste production. Biogas potential from animal waste is calculated approximately as thirty-nine lakh m^3/year and one crore m^3/year from agricultural waste. This amount of biogas generation can efficiently complete the energy demand of the district.

2.6.4.Hydropower Energy

It has an elevation of 1,165 meters on average (4,436 feet). The majority of the land is hilly. In the Uttarkashi district, there are several small and large rivers. The Yamuna and Ganges (Bhagirathi) are the largest and holiest of these rivers.

Commissioned small hydro project falling under Eco-sensitive zone in Uttarkashi		
Pilangad-I	2250 KW	UJVNL
Harshil	200 KW	UREDA
Kedar Ganga	20 KW	UREDA

Rudraganga	150 KW	UREDA
http://moef.gov.in/wp-content/uploads/2017/06/Chapter%20F%20-%20Energy.pdf		

Under construction small hydro projects falling under Eco-sensitive zone in Uttarkashi		
Assiganga-I	4500 KW	UJVNL
Assiganga-II	4500 KW	UJVNL
Kaldigad	9000 KW	UJVNL
Limachagad	3500 KW	UJVNL
Swarigad	2000 KW	UJVNL
http://moef.gov.in/wp-content/uploads/2017/06/Chapter%20F%20-%20Energy.pdf		

Songad	7 MW	UJVNL
Pilangad-II	4 MW	UJVNL
Siyangad	11.50 MW	Harsil hydro ltd.
Kakoragad	12.50 MW	Harsil hydro ltd.
Jalandharygad	24 MW	Harsil hydro ltd.
http://moef.gov.in/wp-content/uploads/2017/06/Chapter%20F%20-%20Energy.pdf		

3 QUALITATIVE DATA ANALYSIS

3.1 AGRICULTURE, ALLIED ACTIVITIES,

3.2 FORESTRY

Due to the inaccessibility of the region and relatively fewer human habitations, the flora and fauna in the district are abundant. This regional forest bears variety of trees, flowers, wild animals, birds, fish and butterflies. Trees of various kinds are found in different altitudinal ranges, for which they are best adapted. Between 1,000 – 2,000 m., the forest cover is almost exclusively of pine. The pine flowers between February and April, the seeds being shed in October. Pine trees are tapped for resin and their dry leaves used as manure. Between 2,000 m – 3,000 m. are found forests of deodar, oak and rhododendron. The wood from oak and rhododendron is utilised for agricultural implements while their leaves serve as cattle -fodder. Several medicinal herbs and plants are found at higher altitudes and in the valleys. Near Nelang village, extensive tracts of padam can be found. The powdered wood of this shrub is used for 'havan' purposes because of its perfume. In the Dayara range are found atish and guggool, used in medicine manufacture. The crushed leaves of

the Chiraita shrub are believed to banish fever in minutes. Another useful plant is the Semru, which exudes a milky substance that produces light when ignited (District Website).

Recently Uttarakhand Forest department announced that they will train 1 lakh residents from the hill districts for 'ecopreneurship'. This ecopreneurs will focus on sustainable businesses. The ecopreneurs will undergo training on conducting birdwatching, snow-leopard tours, nature walks and 'ethical trekking' in tough terrain, a move that is aimed at generating employment opportunities as well as running businesses in an eco-friendly manner. A training session with 20 training modules started at Basru village of Uttarkashi district in month October this year (Time of India, 2021).

3.2.1. Biodiversity

A fascinating array of trees, flowers, wild creatures, birds, fish, and butterflies can be found in the forest cover, ranging from 60 to 80 percent. Trees of diverse types can be found in a variety of altitudinal ranges, each of which is best suited to their needs. The forest cover is almost entirely made up of pine between 1,000 and 2,000 meters. Between February and April, the pine blooms, and the seeds are shed in October. Pine trees are harvested for their resin, and their dried leaves are composted. The tallest pine tree in Asia, at 60.5 meters, may be found at Khoonigad on the way to Arakot from Mori. Deodar, oak, and rhododendron forests can be found between 2,000 and 3,000 meters. Temples are made of deodar (from the Sanskrit deva – daru, divine - tree). Oak and rhododendron wood is used to make agricultural implements, while its leaves are used as cattle feed.

Forests of spruce, birch, and fir can be found above 3,000 meters. In ancient times, the bark of the birch tree (bhojpatra) was used to record manuscripts, some of which are still in good shape. The bugyals, with a diverse range of flowering shrubs, may be found between 3,500 and 4,500 meters.

The Govind Wildlife Sanctuary, also known as Govind Pashu Vihar National Park and Sanctuary, is located in Uttarakhand's Uttarkashi district. The sanctuary, which was established in 1955, spans 958 square kilometers and contains mountains such as Swargarohini, Black Peak, and Bandarpunch. Chirpine, scrub tropical Euphorbia scrub, and oak species can be found at altitudes ranging from 1400 meters to 6323 meters.

3.3 ENERGY

As per the data of the year 2013, Uttarkashi district energy consumption is around 88 TJ/year and 5.0 GJ/capita/year. GHG emission of 6059 Ton CO_2 equivalent and 0.347 Ton CO_2 equivalent/capita has been evaluated for the district.

5.5.1. Solar

The state government has two types of schemes one is solar energy schemes and the other are solar thermal energy schemes. The quantitative data collected gives a glimpse solar energy development in Uttarkashi. According to an article in The Times of India Uttarakhand chief minister Trivendra Singh Rawat on Wednesday inaugurated a 200 KW solar power plant and a 25 KW pine needle (pirul) power plant at Indra Tipri and Chakon villages respectively. “The state government is encouraging green energy-based power projects with an aim to generate employment and protect the environment. These projects can also save nearly Rs 1,000 crore, which the government has to spend for purchase of electricity from other states,” said CM Rawat during his visit to Uttarkashi on Wednesday.

An article in Amar Ujala with the title ‘4.8 MW solar power plant to be set up in Pujargaon Dhanari’ mentions The campaign to generate energy through solar power plants is gaining momentum in the district. Recently, after the inauguration of 200 KW Solar Power Plant at Indra Tipri village, the foundation stone of 4.8 MW Solar Power Plant was laid at Pujargaon Dhanari on Wednesday.

On Wednesday, the foundation stone of 4.8 MW solar power plant was laid at Pujargaon Dhanari along with Bhoomi Pujan. The plant is being set up by Shree Dhaneshwar Project Private Limited Company. Another article in Jagran talks about the same plant and mentions - The biggest solar power plant of the mountain is going to be set up at Pujargaon (Dhanari) of Dunda block, 30 km from the district headquarter Uttarkashi. This five MW plant will be commissioned in February 2021. Vandana, senior project officer of Uttarkashi UREDA, said that with this, 25 villagers would get permanent employment and 24 would get rent for their vacant land. About 500 drains (10.80 lakh sq. ft.) of land was lying vacant in Barari Naame Tok in Pujargaon Dhanari. Earlier the villagers used to cultivate here, but wild animals caused heavy damage to the crop and they could not even get the price of the seed. In view of this, Kanakpal Parmar, the former head of Dunda block, prepared a plan to set up a solar power plant on this land. A rent-nama for 500 drain land was made from 24 villagers. He applied for the plant from his company Shree Dhaneshwar Project Pvt Ltd and partner Sainath Solar Company. On this, approval was given by the government to set up a five MW solar power plant.

5.5.2. Biomass

The people of the district seem to be less aware of biomass energy. Efforts are required to be made so that more and more people turn towards clean and green energy. The district Uttarkashi has two main sources of biomass i.e. forests and agriculture. These if exploited wisely could prove to be a good source of energy in the district.

A news article in Hindustan Times, with the heading 'Uttarakhand gets its first pine needle power generation plant' mentions that the Chief minister Trivendra Singh Rawat inaugurated Uttarakhand's first project for generating power through pine needles with 25KW capacity made at a cost of Rs 25 lakh in Dunda block of Uttarkashi district. The chief minister further informed that 23 lakh metric tonnes of pine needles are produced in the state annually, from which about 200 megawatts of electricity can be produced.

This initiative is appreciable as this project will be very useful to protect the environment from forest fires as pine needles with high resin content are one of the main reasons for the spread of forest fires in Uttarakhand. Due to forest fires, many trees, medicinal plants, vegetation gets destroyed and a large number of wild animals are also affected. With this power generation project using pine needle, forests and animals will be protected. This will also create employment opportunities. So it is evident that government is taking steps for the development of the district in a sustainable manner.

5.5.3. Biogas

A total of five biogas plant capacity two cubic meters was installed in the district in the year 2014-15.

5.5.4. Hydropower

Thirty-six hydropower stations in the district are under construction, and five stations are in operation. As per the report by 'The Statesman,' a 60 MW Naitwar Mori Hydroelectric project under construction in the Uttarkashi district of Uttarakhand was in advanced stages and was likely to be completed by June 2022.

3.4 TOURISM

3.5 WETLAND

Wetlands provide many ecosystems and habitats for a variety of species. Wetlands create a one-of-a-kind ecosystem that supports many species simultaneously, including aquatic, terrestrial, and human beings. The district has numerous potential sources and opportunities to harness valuable products through the scheme and launch the pilot project. Local stakeholders rely on the wetland for income and small-scale business. These businesses can be transformed into large-scale production hubs with the right approach. The district is known for its adventures and trek spots. The district has a long history and religion. The data gathered and analysed demonstrates the region's production and potential products derived from the raw product. The list of sources and the possible products are mentioned below:

- Forestry plays an essential role in the economy of the district. Herbs are the most critical minor forest produce. A large variety of herbs grow wild.

- Sheep rearing for production of wool, orchard raising, spinning and weaving of wool and other cottage industries etc, offers much scope and their potential be exploited to the fullest extent.
- soapstones, iron, graphite, limestone, kyanite and mica deposits occur in the district
- Pine trees are tapped for resin and their dry leaves used as manure
- The powdered wood of this shrub is used for 'havan' purposes because of its perfume. In the Dayara range are found atish and guggool, used in medicine manufacture. The crushed leaves of the Chiraita shrub are believed to banish fever in minutes. Another useful plant is the Semru, which exudes a milky substance that produces light when ignited.

4 ACTION PLAN DEVELOPMENT

4.1 AGRICULTURE

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4.2 FORESTRY

In mountain region forests are the backbone of healthy ecosystems. They also provide productive livelihood resources. Payments for ecosystems services ought to directly benefit the people who forego the use of their forests and other environmental resources. Direct payments to Van Panchayats will encourage them and local communities to conserve, protect and expand their forest cover. The state government must reconsider its attitude towards implementing the Forest Rights Act, 2005. This Act bestows several important rights to Scheduled Tribes and Other Traditional Forest Dwellers, including land rights for dwelling inside forests, rights of ownership, collection and use of minor forest produce from forests.

The Uttarkashi region is mostly based on mountain-based agriculture. Ensuring remunerative livelihoods for mountain dwellers is good option for economic growth of the district. High value crop cultivation – medicinal and aromatic plants, organic farming – combined with basic processing like grading, sorting and packaging at the farm level, dairying, horticulture and floriculture can be the basis for remunerative ecological livelihoods in mountain villages if adequate market linkages are developed (Chopra, 2014).

Neighbouring state Himachal Pradesh has a great forest scheme: 'Van Samridhi Jan Samridhi Yojana.' This scheme enables locals to earn money by growing medicinal plants. This same type of scheme can be implemented throughout the patch of Ganga River meandering through dense forest rich areas. Uttarkashi is one of such areas where important medicinal and aromatic plants exist. These species yield high value in the pharmaceutical industry. Similar schemes if implemented in the district can create competitive market and livelihood opportunities. The network of collection centres can be established in each gram panchayat, these collection centres will provide the monetary benefits along with technical support. These gram panchayats can also start e-commerce and export of medicinal plants to required customers. Establishing the district collection and information centre where industry-local citizen seminars & interaction can happen.

Pharmaceutical firms and other agencies can adopt stands of particular tree species such as timber tree or medicinal tree through e-tendering process. In this system local employment also gets employment opportunity and companies can directly benefit from the raw material availability. Local government can provide e-tendering system and ease of business support so companies can also start manufacturing and export from local to global level. Potential companies can be Dabur, vaidynath, Himalaya, zandu, and other furniture, timber-based companies.

4.2.1. Biodiversity

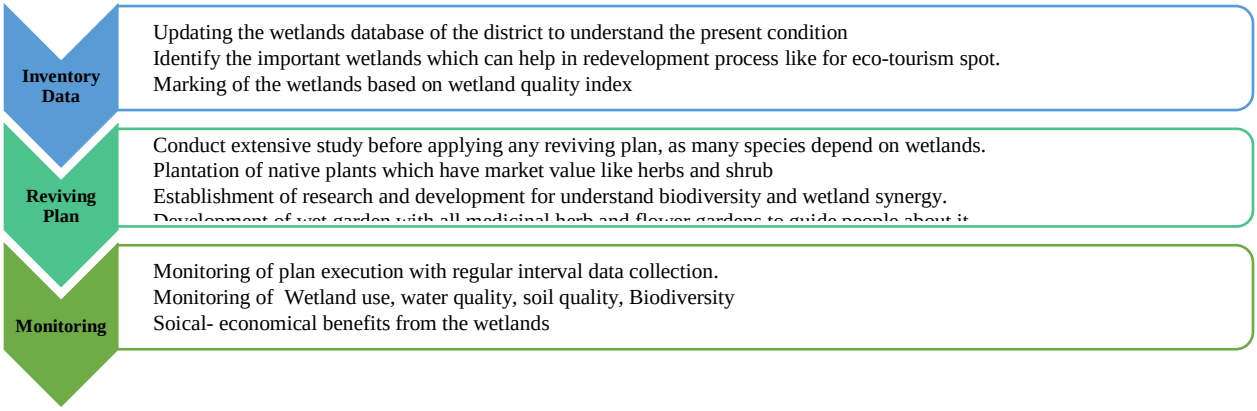
Forests are a source of pride in the district's ecology, not only because of the sheer size of the territory they cover but also because of the diversity of vegetation. The Forest Department manages up to 88 percent of the district's total land area. Pine woods may be found at altitudes ranging from 900 to 2000 meters, and Deodar forests can be found at altitudes ranging from 2000 to 3000 meters. A large variety of herbs grow wild, and these herbs can be a source of income for local people. The potential of forest can be better exploited by locating forest and horticulture-based industries in the district. The tourism business has enormous expansion potential. The terrain offers some of the most unusual spectacles, contrasting between enormous raggedness and breath-taking beauty, and government should promote it for this internationally.

4.3 TOURISM

4.4 WETLANDS

Some of the most productive wetland ecosystems are found in this district. They sustain and offer goods and services to millions of people. They support aquatic vegetation, wildlife, and various bird species, especially migratory birds. Floods are reduced, and groundwater is replenished. They

must be looked after, and action must be made on various fronts. The action plan below shows how to protect, conserve, and revitalise extant and extinct wetlands.



4.5 ENERGY

4.5.1 Solar

The district Uttarkashi has not been developed much in the solar energy sector. Neither the solar thermal form nor the photovoltaic form has gained popularity over the years. The people of the district should be made aware about the solar energy and the policies which government has made. The district has many remote areas which have not been electrified yet due to topographic limitations. Thus it becomes important to provide solar power to these district via off grid solar panels. This is important to improve the livelihood of the people there. In these areas solar cookers, solar room heaters, and the charging devices by using solar energy should also be provided at low prices. It is also important to increase the solar plant installations in urban areas. The district also lacks use of solar energy in any way for the commercial purposes. Use of solar room heaters should be encouraged in hotels, restaurants and guest houses. Solar water heaters should be used in industries wherever required. People's choice for power supply can be inclined towards solar energy by providing subsidy in utility supply to those who use solar power. Kusum Yojana and Mukhyamantri Saur Swarojgar Yojna should be made popularized among the farmers so that they can carry out the agricultural activities in an uninterrupted manner and also they could add to their income.

PROJECTION AND MONITORING MATRIX

Firstly, awareness among people about the solar energy and the policies should be spread. Once the people are aware about the solar energy they would naturally get inclined towards.

Secondly, Kusum Yojana should be promoted among the people. The authorities should work towards establishing the solar feeder segregators under the component C of Kusum Yojana.

Thirdly, to make the remote areas of the district self-sufficient for their energy requirements power packs at low costs should be provided to the households so that they have access to off grid power..

Fourthly, The Mukhyamantri Saur Swarojgar Yojna should be popularized among the people so that the unemployed citizenz of the district can have a source of income.
Lastly, solar thermal energy should be promoted among the people for the heating purposes, especially in the hotels, restaurants, hospitals, etc. Solar water heating systems, solar cooking systems and solar steam cooking systems should be provided at subsidized rates to the people. Grid connected solar panels should also be encouraged in urban areas, which would add to the grid supply supporting the power production.. This would definitely raise the living standards of the people

4.5.2 Biomass

The government has taken initial steps to cope with the forest fire by setting up biomass plant in the district. There is also a need to pay attention to agricultural residue, and the used oil etc. Example can be taken from the fellow district of the state Dehradun, which has launched Repurposed Used Cooking Oil (RUCO) van. A same connectivity needs to the planes for Uttarkashi as well, for not only collecting used oil but also agricultural biomass as well. In order to maintain the availability of biomass throughout the year as agricultural wastes are available only at the time of crop cultivation it is important to connect with and collect other sources of biomass such as industrial waste, municipal solid waste, food waste etc. A district oriented survey should be done to figure out the lands where these plants could be set up. The most suitable place for these plants can be somewhere in between the urban and the rural areas, so that biomass from both the areas can be collected. For this a well-connected collection system needs to be planned by the concerned authorities.
Also such policies should be made for the so that small start-ups are attracted towards setting up co-generation plants, biomass based gasifiers etc.
The other thing required in to make people aware about the biomass energy and its benefits. The government can run campaigns in schools, colleges, panchayats, etc. Once people understand the benefits of biomass energy they will readily contribute in energy production.

PROJECTION AND MONITORING MATRIX

First of all, awareness programs are required to be conducted with the help of NGOs, self-help groups, etc.
Second step can be taking initiative for safety of the people, especially women, collecting pine needles. There should be proper arrangement of transport system for these people. Also an initiation should be taken to enhance the technology for collecting pine needles. This ways pine needle collection would become more efficient.
Third step should be towards making Uttarkashi feasible district for setting up biomass plants by the small start-ups. Also a planned collection system, route and storage is important. This can be done by surveying and analyzing the avalibility of biomass in the specific areas and accordingly

lands for setting up the biomass plants and storage houses should be selected so that transportation of biomass becomes easy.
Fourth step could be that government starts to work for development of 2G ethanol in the district. All these steps would lead to development of the district in a sustainable manner and create employment opportunities.

4.5.3 Biogas

In the past ten years, only five family-size biogas plants have been installed in the district96. Government should build more no. of a biogas plants in the district.

4.5.4 Hydropower

The local population benefits from building these facilities in the form of increased job opportunities and the fulfillment of their electricity needs. As a result, the building of small hydropower projects is a crucial step toward meeting the state's energy needs and promoting economic development.

5 RECOMMENDATIONS

5.1. Agriculture and allied sectors

- There is huge scope for improving the livelihood of local people, regeneration of natural capital, and abating youths' migration through the promotion of organic agriculture, horticulture and agroforestry, and tourism and educational services.

- The government horticulture and forest departments should take uncultivated and barren lands on lease from those individual farmers who do not want to do farming for various reasons. The departments can do large-scale horticulture and agroforestry activities under MGNREGA convergence. These departments can set up horticulture and agroforestry zones and prepare the DPRs under the convergence framework, with detailed techno-economic feasibility and socio-economic and environmental impact analysis. The departments can do wire fencing of these zones to protect the crops and plantations from wild animals. Such fencing would be more cost-effective as compared to the fencing of individual farmers' land.

- Diversification toward horticulture crops, tea plantation, spices and condiments (chilies, ginger and garlic), floriculture and traditional hill grains like, mandua, urad, gahat, bhatt could increase the income of the farmers. Marketing support and R&D intensification can

make these crops more remunerative. One of the major challenges is the transportation of agricultural products from the remote villages to the market; therefore, it is recommended to shift the cropping pattern from traditional crops to high-value and low-volume products.

- Agriculture in the district is almost chemical-free and farmers have a natural advantage to do organic farming. However, there are three deterrents—out-migration, the menace of wild animals and interspersing of cultivated landholding with inactive and abandoned landholding. The possibility of evolving an economically viable model of convergence of MGNREGA activities with the concerned line departments would be explored to promote HVCs and improve people's livelihood.

- The area under forest is about 88.8% of the total reported area. Forest-based livelihood activities have the potential for income generation in the district.

- The soil layers are very shallow and stony type and less fertile except in the valley region, hence to promote the activities, there is a need for advanced agricultural practices, like soil-less agriculture (hydroponics cultivation), greenhouse cultivation, and there is a need for proper training for the advance cultivation.

- Most of the crops are rainfed because of the restricted availability of irrigation water; hence there is a need to develop some rainwater harvesting structures and soil moisture conservation practices (bunding, terracing, mulching, check dams etc.)

- A cluster approach should be adopted in the hill regions. The cluster approach includes the provision of extension services, financial services, inputs, production process, and facilitation of processing. This will help reduce the cost of production, improve yields and generate marketable surpluses. Performance-based credits and subsidy policies can incentivize small and marginal farmers to adopt the best practices.

- There is a requirement to develop mandis at multiple locations of the hill to procure agricultural products at reasonable prices from the local farmers.

- Animal husbandry is one of the important sources of income for rural people. In this district, goats and sheep are the main livestock. The milk production in the district is very poor. Hence, there is a need for intervention of the government's agriculture extension and veterinary systems.

- A three-tier framework of agro-processing (primary, secondary and tertiary processing) can be set up to reduce post-harvest losses and generate value addition and local employment. Primary processing can be done at the cluster level, secondary at local town, and tertiary at SIIDCUL and be well-integrated with the supply chain network.

- A new institutional framework needs to be set up at the district level where the concerned line departments' technical, human and financial resources may be pooled or converged together to provide customized solutions to the farmers related to technology, training, marketing needs and other advisory services.

- The Organic Farming Act is a good initiative, and its provisions should be effectively enforced. A long-term system of incentive as well as regulation may be evolved to retain the existing farmers and motivate others to move towards the sustainable farming system.

- Finally, there should be *a focus* on advanced agricultural activities (soil-less cultivation) through the KVKs training and cooperation.

Since the agricultural practices in the hilly region are different from the plains. Therefore, there is a need for proper strategy and management in agricultural and allied activities.

- Most of the district's land is covered with forest and barren land, there is only 12-15% of the land allocated for agriculture activities, hence, it is recommended that to cultivate the high revenue crops with the installation of proper irrigation (Drip or sprinkler) system.
- Diversification toward the horticulture crops, tea cultivation, spices and condiments (chilies, ginger and garlic), oilseeds, floriculture and traditional hill grains like, mandua, urad, gahat, bhatt could increase the income of the farmers.
- The soil layers are very shallow and stony type and less fertile except in the valley region, hence to promote the activities there is a need for advanced agricultural practices, like soil-less agriculture (hydroponics cultivation), greenhouse cultivation, and there is a need for proper training for the advance cultivation.
- Most of the crops are rainfed because of the restricted availability of irrigation water, hence there is a need to develop some rainwater harvesting structure and soil moisture conservation practices (bunding, terracing, mulching, check dams etc.)
- There is high scope to promote agriculture based on medicinal, herbal and aromatic plantation. Since markets are a major problem, links between the retailers and firms should be propagated by signing an MOU backed by the legislation to prevent the exploitation of farmers. This should be in coordination with the Herbal Research and Development Institute (HRDI) to help farmers in selecting village-specific commodities.
- There is a huge opportunity for the promoting of organic-based agriculture and products
- A cluster approach should be adopted in the hill regions. The cluster approach includes the provision of extension services, financial services, inputs, production process and facilitation of processing. This will help reduce the cost of production, improve yields and generate marketable surpluses. Performance-based credits and subsidy policies can incentivise small and marginal farmers to adopt the best practices.
- There is a requirement to develop mandis at multiple locations of the hill to procure agricultural products at reasonable prices from the local farmers.
- Animal husbandry is one of the important sources of income for rural people. In this district, goat and sheep are the main live-stock. The milk production in the district is very poor. Hence, there is a need for intervention of the government's agriculture extension and veterinary systems.

- There is a need to encourage the agro-based MSMEs, industrial activities to promote agricultural and allied activities. This could increase the income of the local agro-based industries (e.g. herbs, fruits, frozen tulsi, jam, fruit juices, etc.) and also be beneficial for the farmers.
- In this district, one of the major problems faced by the farmers is the storage of their raw agricultural products, they are not able to store their agricultural products for a long time, which reduces the farmer's income. Hence, it is highly recommendable that to construct some cold storage in the district to prevent the losses of the farmers.
- Finally, there should be a higher focus on advanced agricultural activities (soil less cultivation) through the KVKs training and cooperation.

5.2. Forestry

- Uttarkashi currently hold enough forest area to fulfil the national policy requirement of 33%. But what district lacks is organisational productivity through forestry sector.
- It is important for local government and policy makers to establish trust between forest product collectors and organisations Local government can invite foreign investors and Indian pharmaceutical companies for collaboration between tribal people and new business opportunities.
- Major timber species are found in the district, and also various medicinal plants are present in the region. There is huge potential for clusters and emporiums to sell these products to the tourists in the region.
- District is famous for religious places and dense forests. Eco-tourism combined with marketing of the local NTFP products can be beneficial for the district economy.
- The district has two prominent religious places: Gangotri and Yamunotri, these places can be focused for selling and marketing of wood products and NTFPs.

5.2.1. Biodiversity

- It is recommended to promote the district for its beautiful landscape and forest areas.

5.3. Tourism

5.4. Wetlands

The wetlands must be preserved, but they must also be wisely planned in order to benefit the district economically, socially, and environmentally, resulting in a significant reduction in stress from the Ganga River. It will also reduce the local population's reliance on the Ganga river for small-scale industry or basic daily needs. The following recommendations and interventions are

required to obtain valuable products and resolve issues/challenges faced by the people of that region.

- It is recommended to preserve and develop the Dodital as an eco-tourism spot.
- Training the local people about organic farming to build small farms of medicinal plants and herbs
- It is recommended to promote animal husbandry, especially sheep in the area. This boosts the economic growth of the local people, and government intervention is required to set up an Agricultural & Livestock Produce Market Committee to collect finished goods from local people to sell in the national and international market.
- It is recommended to promote forest areas in the region to support the forest-related industry, and wetlands can support the water supply for the cultivation.
- It is recommended that government institutions collect the forest products make available to small industries to develop eco-friendly products like handicraft products.
- It is recommended to develop wet gardens or flower gardens with Brahmakamal and Hemkamal.

5.5. Energy

5.5.1. Solar

- Awareness about the solar energy and the policies that have been made in this regard should be done amomg the people in the district.
- The district needs to plan and implement policies utilizing solar energy for commercial purposes.
- The urban areas should also be given attention in increasing the use of solar energy. Research work is required in overcoming the obstacles in Mukhyamantri Saur Swarojgar Yojana and other such future schemes.
- Grid-connected solar plants should be encouraged to aid the power production of UPCL. Use of solar thermal energy should also be increased.

5.5.2. Biomass

- Initially government should conduct awareness programs and demonstrate to the people about the success stories of other districts. People should also be made to realize the biomass potential of their state.
- Small start-ups should be encouraged to set up biomass based co-generation plants or biomass based gasifiers, for the utilization of rice and wheat residues.
- Those working for the collection of pine needles, especially women, should be provided with better safety.

5.5.3. Biogas

- Biogas plants and its benefit should be taught in schools and local peoples should be aware by making posters or pamphlets.

5.5.4. Hydropower

- It is recommended to identify the eco-sensitive zone in the district before constructing hydropower projects.

6. Discussion during the Report Presentation

- The activities are being taken of the rejuvenation of Water bodies.
- The district is an eco-sensitive zone and hence the suggestions will be taken up for further discussions with NMCG
- The training for Natural Farming will be taken up in coordination with Namami Gange.
- The IIML Report for Arth Ganga should be a regular Agenda item for next 6-8 DGC meetings.
- Hon'ble PM during the post-Budget webinar on Tourism had spoken about market potential of destination weddings. It was suggested that suitable Ashrams in Ganga Basin may be identified for such purpose to promote blissful experience, cost reduction, livelihood opportunities and better upkeep.
- Allocate separate space for Namami Gange Awareness and Jalaj Marketing kiosk in Melas/Congregatios/Fairs for providing better marketing opportunities to the Jalaj products.
- As Dilli Haat Centre – Namami Gange Awareness and Marketing Centre – is being launched soon, it was requested that every district to identify niche products with a creative story and link it with Jalaj in their area.
- To identify Arth Ganga Tourist Trails and organize Ganga Guide training
- Promotion of Natural Farming in Ganga Basin and training workshops should be organized on a regular basis. NMCG is supporting this initiative in coordination with MoA& FW and NCOF.
- Make plans for reuse of treated waste water for agriculture, industrial etc. purpose and also the sludge.
- Training of volunteers for Ganga awareness & Aarti workshops to promote regular aartis on Ghats.

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6 APPENDICES

Table 2 Biogas potential from animal waste.

Livestock	Residue type	Total population as of 2012	Manure yield* (kg/day)	Total manure generation annually (kg)	Average collection (75%)	Dry manure after removing Moisture content	Manure required for biogas* (kg/m^3)	Biogas potential (m^3/yr)
Cattle	Manure	110733	10	40,41,75,450	303131587.5	60626317.5	25	2425052.7
Buffalo	Manure	30903	15	16,91,93,925	126895443.8	25379088.75	25	1015163.55
Sheep	Manure	93883	1	3,42,67,295	25700471.25	5140094.25	25	205603.77
Goat	Manure	120792	1	4,40,89,080	33066810	6613362	25	264534.48
Pig	Manure	235	2.5	2,14,438	160828.125	32165.625	25	1286.625
Poultry	manure	25,682	0.1	9,37,393	703044.75	140608.95	25	5624.358
Total		**3,82,228**						**3917265.483**

Table 3 Biogas potential from agricultural waste.

Crop	residue type	Total crop production (tons) (2017-18)	Residue production ratio	Residue amount (tons)	Average collection (70%)	Moisture content	Residue amount after removing moisture (tons)	Biogas potential [m3/(tons of dry matter)]	Overall biogas potential (m3)
Maize	straw	601	1.5	901.5	631.05	15	536.3925	800	429114
Wheat	straw	16957	1.5	25435.5	17804.85	30	12463.395	800	9970716
Rice	husk	16973	0.25	4243.25	2970.275	80	594.055	750	445541.25
Total		**34531**							**10845371.25**