Arth Ganga: District Chamoli

Submitted by:

September 2021

Submitted to

NATIONAL MISSION FOR CLEAN GANGA

IIM Lucknow

IIT Roorkee

Contents

EXECUTIVE SUMMARY

Chamoli Situated in the Himalayan range and embraces vast natural beauty. The district is connected with National Highway. The district has famous tourist's places such as Badrinath, Hemkund Sahib, Joshimath etc. Also, the district has a huge valley of flowers, UNESCO recognizes it.

In the Chamoli district, Rice, Wheat and Ragi are the principal crops. Saawa, Potatoes and Urad are some minor crops cultivated here. The district has a natural advantage for organic farming (OF) as agriculture is almost chemical-free and the region is suitable for horticulture and livestock. Thus, farming produce in this region is a premium of quality. However, lack of marketing of organic produce and poor road connectivity is a major obstacle. Horticulture production such as Apple, Peach is very high in the district, so there is an excellent opportunity to develop multiple medium-scale industries to process these fruits into finished products.

The district is not blessed with a large number of wetlands, but it has some vital biodiversity. The district consists of hotspots like the valley of flowers and Auli lake, which are part of natural heritage. There are around 22 wetlands sized greater than 2.25 Ha and 49 less than 2.25 Ha areas. The region consists of small wetlands only. These wetlands turn into frozen water land in winter, creating opportunities to organize skiing and other ice-based sports in the district, creating avenues for tourism.

The district has several national parks and wildlife sanctuaries. The Nanda Devi and Valley of Flowers National Parks are famous for their meadows of endemic alpine flowers and outstanding natural beauty. This diverse environment is also home to rare and endangered animals such as the Asiatic black bear, snow leopard, brown bear, and blue sheep. However, uncontrolled fires have posed the biggest threat to the forests. Forest fires occur from March to June due to high temperature, extreme dryness, windy conditions, and low humidity in the forest floor. There is a need to protect these forests, especially during the summer season.

Chamoli district has potential for cultural, pilgrimage, adventure, wildlife and leisure tourism and has the scope to develop niche markets. It is the first state to create a Tourism Development Board by legislation. It has already been awarded National Tourism Award by GOI in 2003- in the category of 'Best Practices by the state government'. Chamoli also comprises India's last inhabited village on Indo-Tibet Border called Mana, which has become a popular place to visit. Several circuits for Mahabharata, Buddhism and adventure/ nature trails may be developed out of all of these places.

In Chamoli, Hydro-Energy is the most popular, followed by solar energy and bioenergy. The district has 298 upgraded watermills, out of which 185 are electrical watermills, and 113 are mechanical watermills. After hydro energy, usage of solar energy is very high. The district has been commissioned 177 Solar Power Plants. Solar street lights, solar lanterns, solar water heating, solar cooker, village electrification through solar energy are installed and many more are proposed to come up in the district. Hence, the district has been doing well in the utilization of solar energy.

Chamoli at a Glance

Chamoli is a district in the upper regions of Himalayas in Uttrakhand. The average elevation ranges from 8000m to 800m. These natural difficulties along with economic negligence of the district have caused massive problems for the local population. The economic activities are far and few. Even in agriculture, the past decades have seen great decline. The green revolution has not reached the district like it has in rest of the ganga plains. Tourism and associated activities are the only important source of earnings here. Even horticultural production (apples and pears) is on the decline.

To add to this overall grim picture, energy is a major issue here. Due to the difficult terrain, it is difficult to set up proper distribution lines and decentralized energy production has not been heeded to in time. Energy deficit combined with an outmigration cause a vicious cycle for existing companies and factories. When the factories close down, it disincentivizes the electricity suppliers and labor, which causes further outmigration etc.

The silver linings of the above problems are avenues for eco-tourism, organic farming, and availability of rare medicinal species etc. The absence of western style development may be a blessing in disguise and future developments need to be done with the understanding that helps conserve the nature while improving livelihood.

1) DISTRICT OVERVIEW

a) Introduction[1]

Chamoli occupies an area of **8,030 square kilometres** and shares its northern boundary with Tibet (China). The district headquarter is situated at **Gopeshwar** around 10 kilometres west of Chamoli town. The district hosts a variety of destinations of pilgrim and tourist interest. It also happens to be a birthplace of the **'Chipko Movement.'** It lies in the Central Himalaya and constitutes a part of the celebrated '**Kedar Kshetra'**. It is surrounded by Uttarkashi in North-West, Pithoragarh in South-West, Almora in Southeast, Rudraprayag in South-West, and Tehri Grahwal in the West.

(Source: https://chamoli.gov.in/map-of-district/)

The section of the Himalayan range in the district is deeply cut into by the headwaters of the Alaknanda river, this trunk stream seeming to have reached a later stage of development than its tributaries. The direction of folding in these mountain masses is generally North to South. The geological feature of the district form two major divisions which lies North and South of an imaginary line extending East-Southeast between the villages of Hilang in Joshimath and Loharkhet in the adjoining district of Pithoragarh. The northern division, which is occupied by higher ranges and snow-covered peaks consist entirely of medium to high grade metamorphic rocks and is intruded by later volcanic rocks. The division to the South, occupied by ranges of lower altitude, consists essentially of sedimentary and low-grade metamorphic rock also intruded by later volcanic rocks. Asbestos, Magnesite, Soapstone, Copper, Iron, Gold, Gypsum, Lead, Slate, Limestone, Building Stone, Sulphur, Bitumen, Antimony, Arsenic, Lignite or Brown Marble, Mica and silver are main minerals available in the district.

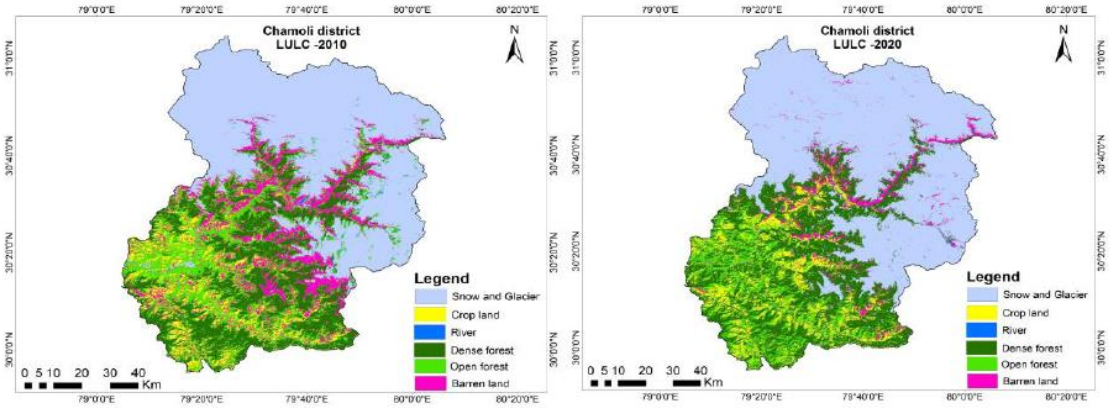
b) Land Use and Land Cover

Snow and Glaciers cover the most area in the district, followed by forests. Crop land is a measly 7.69 %. Share of barren and uncultivable land has increased from 8.35% in 2009-10 to 10.66% in 2017-18. Areas under permanent pastures and under trees and garden have also increased in 2017-18. Net sown area has remained less than four percent during 2009-10 to 2017-18 (Table 6).

[1] https://chamoli.kvk4.in/#

Overall, land-use pattern does not evince any visible change during the last 8 years, except the area under non-agriculture uses in 2017-18 which has significantly reduced. Probably, the area under non-agriculture uses has shifted toward area under pastures and barren and uncultivable land.

These need to be remedied. Barren land and glacier / snow data are not in sync in both. Glaciers and snow appear to have increased contrary to accepted opinion in the GIS data set. Also in the GIS obtained data barren lands seem to have drastically reduced from 10.66% in District Statistical Handbook to 4% in the GIS sets.



c) Climate

As the elevation of the district ranges from 800 mts. to 8000 mts above sea level, the climate of the district largely depends on altitude. The winter season is from about mid-November to March. As most of the region is situated on the southern slops of the outer Himalayas, monsoon currents can enter through the valley, the rainfall being heaviest in the monsoon from June to September.

Rainfall – Most of the rainfall occur during the period June to September when 70 to 80 percent of the annual precipitation is accounted for in the southern half of the district and 55 to 65 percent in the northern half. Rain gauging stations put up at seven locations by Meteorological department of Govt. of India, represent the settled land mass of Chamoli district.

Temperature – The details of temperature recorded at the meteorological observatories in the district show that the highest temperature was 34°C and lowest 0°C. January is the coldest month after which the temperature begins to rise till June or July. During the winter, cold waves in the wake of western disturbances may cause temperature to fall appreciably. Snow accumulation in valleys is considerable.

Humidity – The relative humidity is high during monsoon season, generally exceeding 70% on the average. The driest part of the year is the pre monsoon period when the humidity may drop to 35% during the afternoon.

Cloudiness – Skies are heavily clouded during the monsoon months and for short spells when the region is affected by the passage of western disturbances. During the rest of the year the skies are generally clear to lightly clouded.

Winds – Owing to the nature of terrain local affect are pronounced and when the general prevailing winds not too strong to mask these effect, there is a tendency for diurnal reversal of winds, the flow being anabatic during the day and katabatic at night, the latter being of considerable force.

d) River System

Several important rivers and their tributaries crisscross Chamoli. The Alaknanda River is the main river in the district, which originates from Satopanth-Bhagirat Kharak Group of glaciers. It initially has a West-East course before meeting Saraswati river at Keshav prayag near Mana village at the north of Badrinath Shrine and further it flows almost North-South. Downstream major tributaries as Khiro Ganga join it below the Badrinath shrine at Benakuli, Bhuindar Ganga meets at Govindghat and Dhauli Ganga meets at Vishnuprayag above Joshimath. Small tributaries such as Kalpa Ganga, Garur Ganga, Patal Ganga and Birahi Ganga join it between Joshimath and Chamoli. Nandakini river joins it at Nandprayag and then southeast flowing, Pinder River at Karanprayag The rivers of Chamoli district, generally flow with great force in steep and narrow channels often resulting in excessive erosion and collapse of the banks.

e) Economy and Livelihood Status

Primary sector of the district economy has been constantly declining in term of its share in DGDP. The share went down from 26.28% in 2011-12 to 18.89% in 2016-17, decelerating by rate of - 0.99 per cent. Secondary sector share rose about two percent point from 32.13% to 34% during the same period, thus recoding an average annual growth rate of 6.79%. Similarly, the tertiary sector's share went up from 41% to 46.49% during the same period with an annual growth rate of 8.36%. Overall, the district economy grew at the rate of 5.60 percent per year during the period under study. The real per capita income in the district went up from Rs.90182 in 2011-12 to Rs.108147 in 2016-17, with an annual growth rate of 3.91% per annum. Overall, the economic condition of the people depending on primary sector has worsened vis-à-vis the other sectors.

The primary sector, divided into agriculture and mining & quarrying (M&Q). M&Q recorded an impressive growth of 13.18% per year, though the growth shows ups and downs across years. A high growth rate in M&Q is a serious concern for the ecologically sensitive terrain of the district.

Table: Trends in GDDP in Chamoli 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 DGDP (Rs.)	Growth rate
	93543	114361	145926	355948	-	-	-	-	90182	-
2011-12	(26.28)	(32.13)	(41.00)	(100)						
	98519	121890	149547	370746	5.32	6.58	2.48	4.16	92432	2.49
2012-13	(26.57)	(32.88)	(40.34)	(100)						
	98841	132751	171885	405356	0.33	8.91	14.94	9.34	99425	7.57
2013-14	(24.38)	(32.75)	(42.40)	(100)						
	87650	138534	190883	419679	-11.32	4.36	11.05	3.53	101274	1.86
2014-15	(20.89)	(33.01)	(45.48)	(100)						
2015-16	86064	149232	201702	439683	-1.81	7.72	5.67	4.77	104416	3.10
RE	(19.57)	(33.94)	(45.87)	(100)						
2016-17	88250	158782	217158	467071	2.54	6.40	7.66	6.23	109147	4.53
PE	(18.89)	(34.00)	(46.49)	(100)						
Average growth rate					-0.99	6.79	8.36	5.60	-	3.91

Source: UKDES

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

Table: Trends in Gross District Domestic product from Agriculture and allied activities in Chamoli at Constant Prices (base 2011-12) in Rs. Lakhs.

Year	Agriculture	livestock	Forestry & logging	Fishery	Total Agri, & allied	Mining & Quarrying	Primary Sector
	44590	13706	30551	72	88919	4624	93543
	(50.15)	(15.41)	(34.36)	(0.08)	(100)		
2011-12	--	-	-	-	-	-	-
	49829	15860	29552	74	95315	3205	98519
	(52.28)	(16.64)	(31.00)	(0.08)	(100)		
2012-13	[11.75]	[15.72]	[-3.27]	[2.78]	[7.19]	[-30.69]	[5.32]
	45365	15548	31695	52	92660	6182	98841
	(48.96)	(16.78)	(34.21)	(0.06)	(100)		
2013-14	[-8.96]	[-1.97]	[7.25]	[-29.73]	[-2.79]	[92.89]	[0.33]
	35257	14604	31096	75	81032	6618	87650
	(43.51)	(18.02)	(38.37)	(0.09)	(100)		
2014-15	[-22.28}	[-6.07]	[-1.89]	[44.23]	[-12.55]	[7.05]	[-11.32]
	32652	15064	32366	82	80164	5900	86064
2015-16	(40.73)	(18.79)	(40.37)	(0.10)	(100)		
RE	[-7.39]	[-3.15]	[4.08]	[9.33]	[-1.07]	[-10.85]	[-1.81]
	33077	15413	33333	84	81907	6343	88250
2016-17	(40.38)	(18.82)	(40.70)	(0.10)	(100)		
PE	[1.30]	[2.32]	[2.99]	[2.44]	[2.17]	[7.51]	[2.54]
Average growth	-5.12	1.37	1.83	5.81	-1.41	13.18	-0.99

Source: Compile from UKDES

Note: 1. Figures in () are percentage share in the total agriculture & allied GDDP

1. Figures in [ ] are annual growth rates.

Agriculture including horticulture declined by 5.12 percent per year during 2011-12 and 2016-17. Livestock evinces a growth of 1.37% per year. Forestry and logging contributes significantly to the agriculture and allied sectors' GDP of the district.

Within the secondary sector, manufacturing contributed 52.5-55% share, while construction's share ranged from 25 to 29%. Average annual growth rate was highest in manufacturing (7.85%), followed by construction (6.85%) and electricity gas and water supply (6.59%).

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	52.50	19.89	27.60	100	15.68	29.33	6.94	9.16	23.57	15.32	100
2012-13	54.95	20.07	24.98	100	16.74	31.34	7.30	9.71	16.36	18.55	100
2013-14	52.33	18.59	29.08	100	15.76	29.62	6.96	8.26	20.44	18.97	100
2014-15	52.51	19.26	28.23	100	15.72	28.54	6.96	8.53	21.96	18.29	100
2015-16	54.27	19.27	26.45	100	16.20	28.84	7.14	8.45	21.71	17.66	100
2016-17	55.04	19.68	25.28	100	16.22	29.00	7.01	8.40	20.72	18.66	100
Average annual Growth (%)	7.85	6.59	6.85	6.79	9.02	8.03	8.51	7.49	19.81	12.89	8.36

Source: Estimated from statistical handbooks

Within the tertiary sector, trade, hotels and restaurants constituted the highest share (29%) in 2016-17, followed by public services (20.72%), other services (18.66%) and transport, storage and communication (16.22%). Average annual growth rate is observed highest (19.81%) in public services, distantly followed by other services (12.89%) transport, storage and communication (9.02%), financial services (8.51%) and trade, hotels and restaurants (8.03%).

Overall, the district economy is driven by the growth of non-agriculture sectors as agriculture achieved negative growth. Yet, employment in the district economy is dominated by the primary sector, 62.9% in the district as against 39.3 workers in the state.

2) Quantitative Data Analysis

a) Agriculture and allied

Net Sown Area in the district is less than 4% of the total reported area, indicating very less potential of development of crop sector. Moreover, marginal and small farmers are 93% of the total farmers of the district. Agricultural labor is very hard to come by due to poor alternatives in livelihood and agriculture not being adequate for the youth. Horticulture and Livestocks also have been affected by these trends. Overall the situation of agriculture is dismal despite more than half the district depends on it for livelihood.

Yeilds and Production

Rice, Wheat and Ragi are the principle crops of the district. Saawa, Potatoes and Urad are some minor crops cultivated here. Agriculture of the district is dominated by food grains which comprise 92% of the GCA.

Throughout the period of 2011-2018, yields of wheat and rice have fluctuated from 11 to 14 qt/Ha. As against the state average of 18-20qt/Ha. Ragi and Maize have heartening yields in the district.

Wheat had the highest production (20445 tons), followed by rice (16055 tons) and ragi (14825 tons). These three crops had 83.44 percent share in the total cereal production in 2017-18.

Among pulses, urad had the highest share (27%) in the total pulses production. In the case of oilseed production, soybean is the main crop which comprised about 79 percent share in the total oilseed production in 2017-18. Potato is other important crop in the district. Its production was highest (34544 tons in 2010-11 and lowest in 2012-13 and 2013-14 (6445 tons)

Table: 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	2016-17	2017-18
Rice	13813	17532	14557	15970	15234	14414	14902	14881	16055
Wheat	17854	21943	19786	20873	19922	15386	16121	19417	20445
Barley	2157	2889	2737	2907	2095	2164	1428	2397	2469
Maize	132	175	178	173	168	320	397	397	355
Ragi	14645	14964	13977	16579	15062	12676	13388	15167	14825
Saava	1765	4731	4061	5698	3470	4203	4005	4919	4766
Total Cereal	53356	63583	56508	63431	57867	51116	53151	59534	61511
Urad	316	318	226	397	325	626	502	533	719
Masoor	50	20	49	36	29	28	43	86	48
Matar	4	19	24	9	63	18	77	4	171
Arhar	52	53	45	63	76	98	95	84	108
Total Pulses	1654	1896	1580	1970	1953	2655	2289	2626	2660
Total Food Grains	55010	65479	58088	65401	59820	53771	55430	62160	64171
Mustard	193	309	273	204	204	324	518	453	140
Soyabean	399	435	474	503	503	576	436	374	552
Total Oil Seeds	598	756	754	716	716	913	962	833	695
Potato	34512	34544	30593	6445	6445	22715	17712	12422	22360
Source: District Statistical Handbooks									

Production and yield of vegetables in the district have declined during 2010-11 and 2018-19. Per hectare yield has gone down from 8.92 tons/ha in 2011-12 to 5.79 tons/ha in 2018-19. Similarly, total production steeply declined from 26414 tons in 2011-12 to 12323 tons in 2018-19, a net decline of 53%. The decline is driven largely by the reduction in yield as the area declined by 27%. Area under potato drastically declined from 2836 ha to 559 ha. As a result, the production went down from 38589 tons to 6156 tons. Yield of potato also declined from 13.61 tons/ha in 2011-12 to 11.02 tons/ha in 2018-19.

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	2017-18	2018-19
Potato	A	2889	2960	3437	1279	3403	1933	2046	2094	2130
	P	25640	26414	26495	9782	26215	12217	12219	12032	12323
	Y	8.88	8.92	7.71	7.65	7.7	6.32	5.97	5.74	5.79
Total Vegetables	A	2828	2836	3375	524	2887	539	542	546	559
	P	38497	38589	42722	5939	38665	6028	6065	6110	6156
	Y	13.61	13.61	12.66	11.34	13.39	11.19	11.19	11.19	11.02

Source: Compiled from District Statistical Handbook

Fertilizers, Irrigation and Operational Holdings

Per hectare use of chemical fertilizers is almost negligible. Nitrogen ranges between 1.89 kgs/ha to 2.74 kgs/ha of GCA. Phosphorous use ranges between 0.9 khs/ha to 1.93 kg/ha of GCA. The use of potassium is almost zero. Total fertilizers use ranges from 2.97 to 4.82 kg/ha of GCA. It can be inferred from the fertilizers consumption data that agriculture of the district is chemical-free and farmers have natural advantage to do organic/natural farming.

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

Fertilizer/ Year	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Nitrogen	2.28	2.74	2.28	2.16	2.22	2.63	2.57	1.89	2.03
Phosphorous	1.45	1.72	1.50	1.42	1.46	1.33	1.46	1.93	0.91
Potassium	0.36	0.36	0.06	0.10	0.25	0.00	0.04	0.04	0.02
Total	4.09	4.82	3.84	3.68	3.68	3.96	4.07	3.25	2.97

Source: District Statistical Handbooks

Being as hilly region, surface irrigation structures are favored over groundwater for irrigation. Net cultivated area under irrigation ranges between 4.57 to 5.27 percent. There is no much progress in bringing more area under irrigation. Gross irrigated areas as percentage of GCA is also quite low (4.75-7.51%). Not much progress is made in the addition of canals during the last five years. Number of water tanks has increased from 2849 in 2010-11 to 3466 in 2018-19. Length of *Gool* has increased by 340 kms to 2680 kms during the period. The number of high-drums have not seen significant increase.

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

Name/Year	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Length of Canals (KM)	406	415	416	419	420	421	420	421	421
No. of tanks	2849	2949	3072	3147	3252	3341	3385	3385	3466
Gool in KM	2340	2404	2472	2502	2617	2651	2672	2672	2680
No. of high-drums	161	161	171	171	171	171	171	171	171
% of NIA	4.99	4.62	5.27	4.86	4.89	4.71	4.57	4.59	-
% of GIA	6.21	5.78	6.35	6.26	7.51	6.30	6.07	4.75	-
Source: Compiled from District Statistical Handbooks Note: Being the hilly area, scope of groundwater extraction is negligible in the district.									

Livestocks, horticulture and other allied activities

From rural sustenance to providing natural manure livestock play an all-round important role. During 1998 and 2019, there has not been much decline in the number of female cattle but number male cattle has drastically declined, probability due lack of demand for animal power. Between 2007 and 2012, number of poultry has increased.Milk production did not increase significantly over the period. It ranges from 66850 tons in 2001 to 75000 tons in 2013. Average production of milk is estimated be 71720 tons. The meat production in the district has increased over the period. It went up from 33.18 tons in 2001 to 76.11 tons in 2012 and then decelerated to 59.55 tons in 2015. Eggs' production has substantially increased from 7.64 lakhs eggs in 2001 to 26.43 lakhs eggs in 2015. The declining number of male livestock seems to be closely associated with the growth of meat production in the district.

Table 17: Trends in Milk, Meat and Eggs Production in Chamoli

Year	Milk (1000 tons)	Meat (1000 kg)	Eggs (in Lakhs number)
2001	66.85	33.18	7.64
2002	68.16	33.47	7.89
2003	72.1	33.67	13.04
2004	72.55	33.9	12.68
2005	73.75	33.78	12.53
2006	74.39	34.08	12.41
2007	74.37	32.18	12.26
2008	73.96	27.62	12.66
2009	70.4	28.12	12.68
2010	69.07	30.24	13.62
2011	70.31	30.72	15.89
2012	72.62	76.11	19.23

2013	75.00	73.69	22.18
2014	70.43	55.96	25.07
2015	71.94	59.51	26.43
Average	71.72	41.10	15.10
CAGR (%)	0.20	5.00*	7.74*
Source: ICRESAT Database Note: * significant at 1% level of significance.			

With policy support and well-designed action plan, horticulture can be the growth driver. Apple has the highest share (29.71%), followed citrus fruits (19.19%), and walnut (14.64%).PrProduction of

Production of apple ranges from 2891 tons in 2018-19 to 23406 tons in 2010-11. Its production has steeply declined in recent years. Production of almost all fruits have massively declined in 2018-19 when compared to 2010-11. Total production of fruits has declined from 100652 tons in 2011-12 to 12828 tons in 20-18-19.

Table 19: Year-wise production of fruit crops in Chamoli 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
Citrus fruits	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

Similarly per hectare yield of almost all horticulture crops has declined during 2011-12 and 2018-19. Apple decelerated from 5.74 tons/Ha to 2.33 tons/Ha. Yield of Pears had ups and downs during the period. Per hectare yield of other fruits(peach, plum, apricot, walnut, citrus and mango) have declined during 2010-11 and 2018-19. Overall, productivity went down from the peak of 6.69 tons/ha in 2014-15 to 2.75 tons/ha in 2018-19. The reasons for this dismal condition of horticulture in the district need to be explored.

Table 20: Per hectare yield of principal fruits in Chamoli District (tons/ha)									
Crop/Year	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Apple	5.74	5.56	5.51	4.16	4.91	3.14	2.88	2.79	2.33
Pear	8.54	8.64	8.25	4.42	7.17	12.82	12.26	11.49	5.16
Peach	6.92	7.0	7.04	4.16	5.57	3.77	3.71	3.58	3.02
Plum	7.7	7.3	6.63	3.59	4.34	2.75	2.33	2.29	2.37
Apricot	0.68	6.98	6.79	4.53	4.68	4.42	4.44	4.42	4.06
Walnut	5.04	4.91	4.14	1.88	4.1	1.83	1.73	1.73	1.52
Citrus fruits	7.48	7.23	6.89	4.95	7.09	5	4.95	4.95	4.69
Mango	4.82	4.69	4.38	2.89	4.5	2.69	2.42	2.42	2.23
Other Fruits	7.58	6.7	6.35	5.36	5.46	5.33	4.14	4.14	3.63
Total	6.64	6.47	6.16	4.09	6.69	4.18	3.82	3.82	2.75
Source: Compiled from District Statistical Handbooks									

Labour situation

Due to lop-sided development in the state during the post-statehood period, the intensity of out-migration has increased (Mamgain & Reddy, 2015). Moreover, nature of out-migration has been gradually changing from seasonal or temporary to permanent, having far-reaching consequences for the rural economy. The exodus 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 abandonment of agriculture to a greater extent.

Tourism is key growth driver of the district economy. It can be integrated with the promotion of high-value crops (HVCs) such as vegetables, fruits, mushroom, flowers and medicinal crops. If HVCs are promoted, hotels and dhabas, largely driven by the tourists, may get fresh vegetables and fruits and other food items from the local farmers. It may be relevant to mention that floating population in the district may be even more than actual population. This population needs different kinds of agro-products which can be supplied by the local market. Diversifying agriculture and allied activities toward low volume and high value agro-products would not only check the out-migration, but also would work as a multiplier in the local economy, generating additional employment avenues in the non-farm activities. There are three deterrents—out-migration, menace of wild animals and interspersing of cultivated land holding with inactive and abandoned land holding. Possibility of evolving an economically viable model of convergence of MGNREGA activities with the concerned line departments would be explored for promotion of HVCs and improving the people's livelihood. Uttarakhand Human Development Report (2018) shows that about three-fourth of total first-time migrant in Chamoli migrated alone and about 19 percent with family members.

Organic Farming

To promote sustainable agricultural practices and improve the farmers' livelihood, 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 Borad (UOCB) in 2003 as a nodal agency to facilitate organic clusters and provide technical support to promote organic farming. Area under organic farming is 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). Uttrakhand is the first state of India which enacted Organic Farming Act in 2020 and declared 10 of its blocks fully organic. Deval Block of Chamoli district is one of such blocks in the state. The hill districts of the state, including Chamoli, have the natural advantage organic farming as per hectare use of chemical fertilizers is quite low.

As on June 30, 2021, there are total 588 organic farming groups with 30431 registered farmers in the district. Out of these group, about 82% constituted under the PKVY and 18% under the Namami Gange. The highest number of groups and number of farmers are in Karnaprayag (92 and 4509), followed by Gairsain (74 and 3857) and Pokhari (60 and 3015) and lowest in Joshimath (27 and 1307).

b) Wetlands

The district is not blessed with a large number of wetlands, but it has some vital biodiversity. The district consists of hotspots like the valley of flower and Auli lake, which are part of natural heritage. The district has an average temperature of 21.87°C and rainfall of around 531.80 mm. There are around 22 wetlands sized greater than 2.25 Ha and 49 less than 2.25 Ha areas. The region consists of small wetlands only, generally less than 20 Ha in area.

Wetlands, in particular marshes, play a major role in treating and detoxifying wastes. These are low-cost measures to reduce point and non-point pollution. Water purifying plants should be planted along the wetlands.

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	9	14	5	0	4	4	1	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	8	8	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 (71)	**9**	**22**	**13**	**49**	**4**	**4**	**1**	**0**	**0**	**0**	**0**	**0**	**0**

Source: National wetland Inventory 2006-07 NRCD (National River Conservation Directorate) 2008

-National Wetland Inventory and Assessment (NWIA) Atlas Space Application Centre-ISRO (2007)

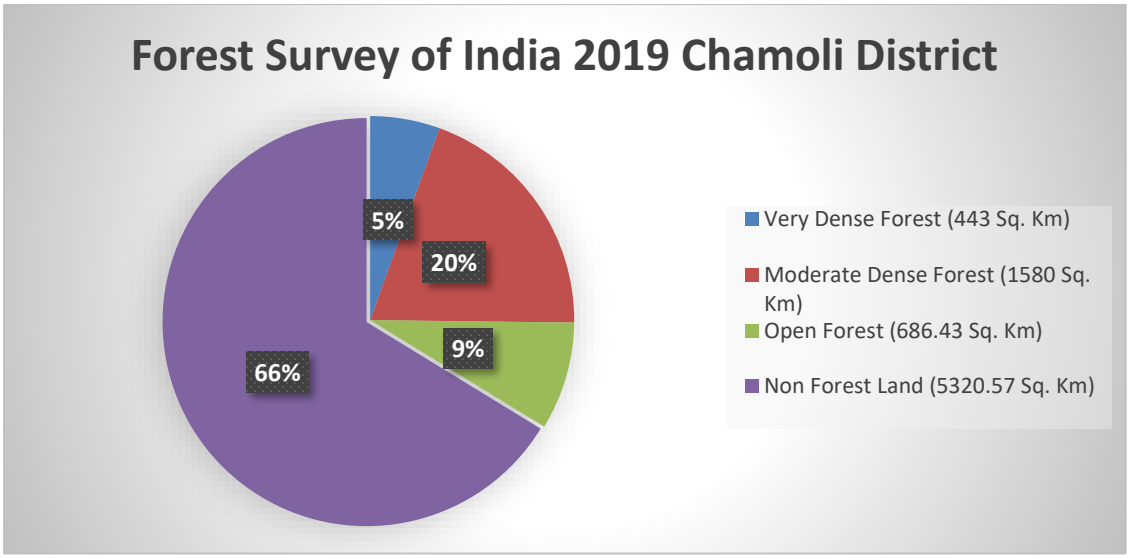
As per "Wetland Atlas Report"

- Chamoli district comprises 71 wetlands; most of them are high altitude wetlands and rivers/streams. The high-altitude wetland type is a unique feature of the district as it makes the district an attractive place for tourism.
- These wetlands turn into frozen water land in winter, creating opportunities to organize skiing and other ice-based sports in the district, creating avenues for tourism.
- The district has many hotspots, which lead to a high inflow of tourists in peak season. However, at the same time, the district is also fragile, which leads to experiencing lots of calamities.

c) Forests

Forest Cover:

The **58,684** hectares of forest area diverted in Uttarakhand in the last 30 years is equivalent to **2.4%** of the State's total forest area as of **2019.** Chamoli district, which bore the **brunt of the floods**, witnessed the second-highest diversion. The majority of land was diverted for **transmission lines, road laying, and hydel project.**



Forest Products:

Chamoli forest produces mainly two types of forest products: 1. Timber Based 2. Non-Timber Based. Total 3940.6114 tonne of timber is produced as per local forest administration report. The quantity of fodder produced is 1540.50 tonne and 2400.1114 tonnes is small timber. 1457.94 m^3 of firewood is produced. From Non-Timber Forest products, resin has highest production rate of 54877.86 quintal. Production of Medicinal plants and forest flowers, fruits vary with area and altitude and is comparatively small in quantity. Various local plant species are used in traditional healthcare practices. Native communities rely on these traditional practices under the supervision of local Vaidya (Bisht, 2013).

d) Energy

The energy-development relationship has numerous social and political implications in Uttarakhand. Villages are scattered and most of the area is hilly and forest (66%). With the interspersed terrain and strict forest laws it's is difficult to lay the grid lines or operationalize any project. Hence in Chamoli, Hydro-Energy is the most popular, followed by solar energy and bio energy.

Hydel Energy

As a solution of this problem- **Decentralized Distributed Generation (DDG) Micro & Mini Hydro Projects** are suitable and best way to provide **electricity facility** to the forest fringe and scattered villages. Operation and maintenance of **Standalone Micro Hydroelectric Power Plants** can be done in easy manner by local community after a formal training.

Chamoli district has 298 upgraded watermills, out of which 185 are electrical watermills and 113 are mechanical watermills. (till August 2013). An up-graded watermill produces power up to 5 Kw which is sufficient for electrification of 15-20 families within a diameter of 500 meters. Chamoli has 7 micro hydel projects ranging from 100kw to 25 kws. There are 20 new projects identified, significantly nandakini and sufaligad plants of 2000kw.

Solar Energy

In 2017-18 financial year (FY) under Grid Connected Rooftop Solar Power Plant scheme (Project installed in hilly district of Uttarakhand of capacity 4/5 KWp each), there have been 177 Solar Power Plants commissioned in Chamoli district.There have been 20 Off-Grid Solar Power Plants installed in Vikash Bhawan Gopeshwar Chamoli. Under the Mid-day Meal programme in Govt. schools, 744 Dish Type Solar Cookers have been installed in Chamoli in the FY 2015-16. 902 street lights are proposed and 33 installed as of 2016-17.

Biogas-Enegry

Biogas plants have been facilitated to provide clean bio-gaseous fuel mainly for cooking purpose and also for other applications for reducing use of LPG and other conventional fuels.

To improve sanitation in villages by linking sanitary toilets with biogas plants; To mitigate Climate Change by preventing black carbon and methane emissions. In 2011-12, as many as 20 biogas plants and in 2012-13, eight biogas plants were installed in Chamoli. From 2013 to 2020, 67 biogas plants have been installed in the district.

MNRE is providing a subsidy on family size biogas plants under National Biogas Manure management Programme (NBMMP). Biogas Plants capacity ranging 2-4 Cum capacity are to be installed under this program. Family Size Biogas Plants . The 4356 Family Size Biogas plants have been installed in various districts of Uttarakhand to date.

e) Tourism

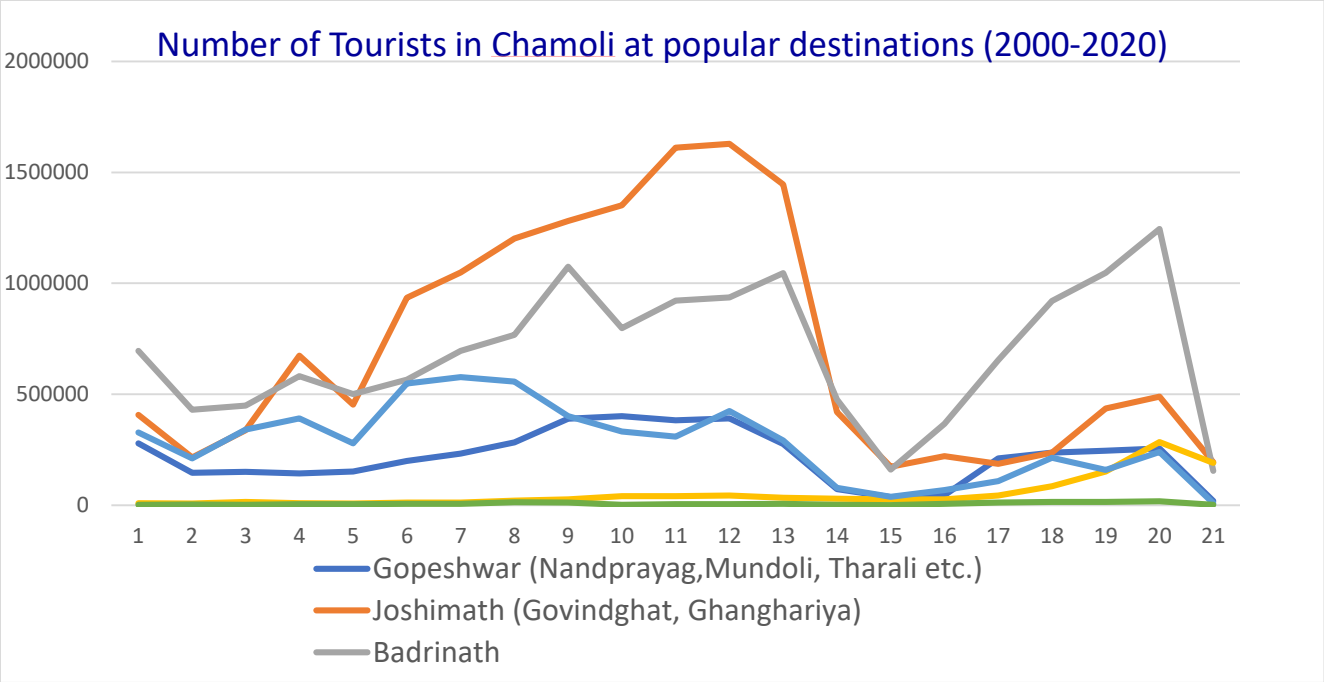
Economic Contribution

Like Uttarakhand as a state, the District Chamoli has potential for cultural, pilgrimage, adventure, wildlife and leisure tourism and has scope to develop niche markets. It is the first state to create a Tourism Development Board by legislations. It has already been awarded National Tourism Award by GOI in 2003- in the category of 'Best Practices by the state government'.

	2011-12	2012-13	2013-14	2014-15	2015-16RE	2016-17PE
Tertiary	145926	149547	171885	190883	201702	217158
Trade, repair, hotels and restaurants	42799	46864	50907	54484	58169	62969
% contribution of trade, repair, … to GDDP	12.02	12.64	12.55	12.98	13.22	13. 48

Table : Contributions of Hotels and Restaurants in Chamoli (in Lakhs) at constant prices
Source: calculated from District statistical handbook

The contribution of Tertiary sector to Chamoli's GDP is the highest and trade, repair, hotel and restaurant has the increasing potential to contribute to the economy. Therefore, tourism sector in the district can further be promoted to harness its growth and benefits to the district economy. Promoting primary sector further by making adequate policy decision to align products like organic farming products, horticulture and handicrafts (which gets raw materials from forest, livestock and agriculture system) to the tourism sector.
Thus, expansion of tourism with primary sectors in agriculture, forestry can have synergizing effects.

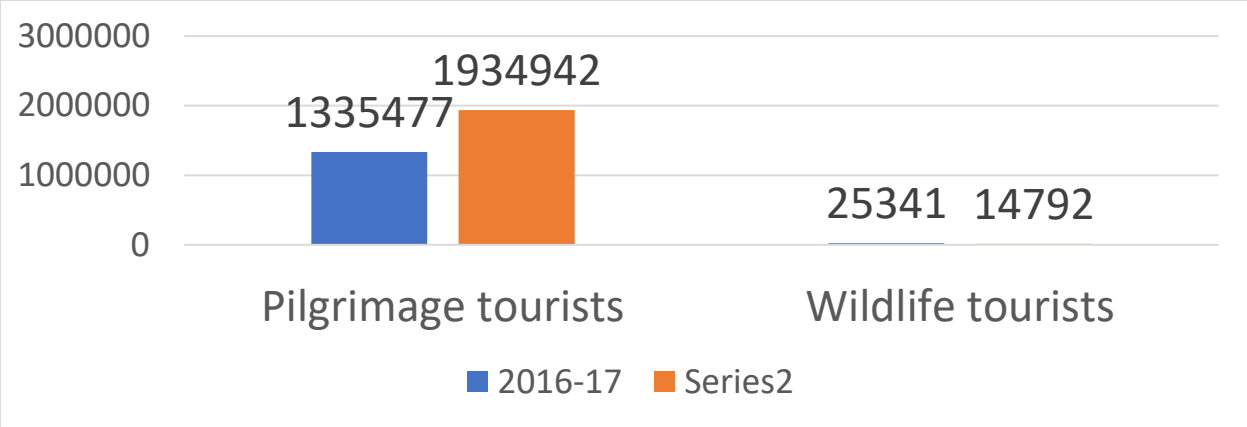


Tourists Arrival at specific sites in Chamoli (2000 to 2020)
(Data compiled from Uttarakhandtourism)

Environmental Concerns and Trade Offs

However, promoting tourism sector by considering its economic contribution may lead to bad policy decisions without noting the fragile nature of the micro tourism spatial ecosystem. Taking a long data set on tourism foot falls and disasters, their correlation may be conjectured. For example, the occurrence of Chamoli cloud burst and disaster in 2013, may be perceived to be associated and hypothesized to have correlation with the carrying capacity of fragile spatial ecosystem which needs further development of projects and research. In this figure, we can see that the tourists' footfall at the fragile ecosystems of Joshimath, where the disaster occurred, is the highest in 2013 during the last 20 years. Hence, appropriate policy decisions must be made like putting a cap on the tourists' size and measuring their impacts through adequate researches.

The impact of the disaster has been reflected in terms of reducing the annual growth rate of the district from 9.34% to 3.53 in 2013-14 and has its subsequent spread effects for next two years. While the state annual GDP growth was affected during 2014-15 which is the lowest growth rate during a 5-year period; the effect of the disaster has negatively affected the district annual GDP growth rate for subsequent years. This states that disaster largely has a micro regional impacts, hence disaster and development related policies must be made be made taking into account micro regional contexts and be site specific. This is because of the difference in biophysical and geographical difference that exists across districts in the state of Uttrakhand. Hence, district specific plans must be developed for these states rather than state specific.



Compiled from Uttarakhand tourism, 2019, 2017

Again, on the basis of nature and typology of tourism is concerned, we can find that there has been an increase in pilgrimage/religious tourism by around 45%; whereas there has been a decrease in wildlife tourism by 41.62 %. This figure suggests that we must put a cap on the number of tourists in each of the religious tourists spots for maintaining its originality and sustainability. And tourists number can be controlled and managed in each of the fragile religious/pilgrimage site by introducing entry fee/user charges which can serve as double weapon of protecting the fragility of the site and earning exchequer for the development and protection of the site. The number of wild life /nature tourists has fall down significantly which may be because wildlife tourism is costlier since it puts user charges/entry fees and visiting the national parks like Valley of Flowers is a challenging job and expensive**.**

Tourism Infrastructure and Avenues

It is good that tourism infrastructure and involvement of local stakeholders in tourism related activities are increasing. Number of hotels and paying guests have increased from 418(2016-17) to 435 (2018-19). Number of Dharmshalas are declining from 35 to 31 in the district.

Several attempts are being made towards sustainable tourism. One of them is promoting Stakeholders' Engagements in Tourism by Registered Homestays in 3 categories (Gold, Silver and Bronze)

	Urban			**Rural**		
Category	Units	No. of seats	No of beds	Units	No. of seats	No. of beds
Gold	2	7	20	4	18	36
Silver	9	44	92	12	44	103
Bronze	4	14	28	95	288	602
Total 2019	15	65	140	111	350	741
2017	0	0	0	2	14	24

Mapping Tourism Spots in Chamoli is another step in supporting tourism. Existing opportunites are divided into:

Religious Tourism: Several important temples and centers for spiritual rejuvenation and growth

Cultural Tourism: Mana: The last Indian settlement, land of Saraswati river has been designed as a ‘tourism village’; Niti village for woolen handicrafts, Nauti Village, Nand Prayag Town etc.

Ghat/Adventure/Eco-Toursim: Along with holy dip and sacred bath, ghat tourism can have multipurpose destinations and attractions. Ghats can also be gateway to adventure sports and trekking. Or a natural retreat. Destinations like Bhramataal and Basundhara waterfalls provide picteresqu view to cherish and attract several high tourists.

3) Qualitative Understanding

a) Agriculture & Allied, Forestry, Wetlands

For the purposes of development and projects, Forestry and Wetlands have undeniable synergies and threats linked to agriculture. Agriculture is dependent on Forests and Wetlands for services like pollination (through bees etc.), pollution control (by water bodies), nutrient cycling etc. Agriculture is also the activity which has greatest capability to disturb the balances for these pillars. Hence it is wise to put all their understanding in a holistic perspective and consider them together.

Organic Farming

SWOT Analysis of Organic Farming in the District

Strengths	Weaknesses
• Suitability of agro-ecology for horticulture and livestock • Agro-biodiversity and multiple cropping System • A natural advantage for organic farming (OF) as agriculture is almost chemical-free • The abundance of organic manure (forest leaves and cattle urine & Dung) • Community-based certification system (PGS) • Less dependence on external inputs • Agriculture and Horticulture Universities in the region • Market Proximity (Dehradun, Delhi NCR)	• Ecological Fragility • Small and scattered land holdings • Lower productivity during the transition period • Inadequate marketing infrastructure and market linkages • Knowledge and skills-deficit in OF • Lack of effective monitoring • Inadequate irrigation facilities • Inadequate testing and certification system • Lack of effective farmers' Organization • Poor road connectivity to remote villages
Opportunities	**Threats**
• Consolidation of agricultural holdings • Income-elastic demand for organic products • Crop-livestock integrated farming system • High tourists flow and scope for agro-tourism • Common "Namami Gange" brand • Possibility of Convergence with MGNREGA • Local employment generation • Agro-processing at primary and secondary levels • Government Institutional and policy support	• The intrusion of wild animals • Abandonment of agriculture due to out-migration • Vulnerability to natural factors (landslides and disasters) • The declining number of cattle and buffaloes • High transaction cost • Market risks • Women drudgery

Forests and Ecosystem

Chamoli district has several national parks and wildlife sanctuaries. Each have varying degrees of restrictions and legal protections. The core sanctuaries of pristine forest lands have best health of living inhabitants and best nutrients in non-living components like soil etc. Any produce that these regions bestow to us are the best. Thus farming produce obtained closer to them should have a premium of quality. At the same time the robust health of mother nature should not be traded in for higher yields etc. through HYV seeds and indiscriminate pesticides and fertilizers.

Forest produce should involve several tribal populations etc. These produce should provide chances of employment for local community while empowering them to protect the natural flair of the region.

The Nanda Devi national park lies in central Uttarakhand across the main crest of the Great Himalayan Range. This Reserve is in the UNESCO World Network of Biosphere Reserves since 2004. The valley was declared a national park in 1982 and now it is a World Heritage Site. The Valley of Flowers is another National Park famous for its meadows of endemic alpine flowers and outstanding natural beauty. It is located high in the West Himalayas. This diverse environment is also home to rare and endangered animals such as the Asiatic black bear, snow leopard, brown bear, and blue sheep. The Valley of Flowers National Park's gentle landscape contrasts with the rugged mountain wilderness of Nanda Devi National Park. They form a unique transition zone between the Zanskar and Great Himalaya mountain ranges, praised by mountaineers and botanists for over a century and in Hindu mythology for much longer.

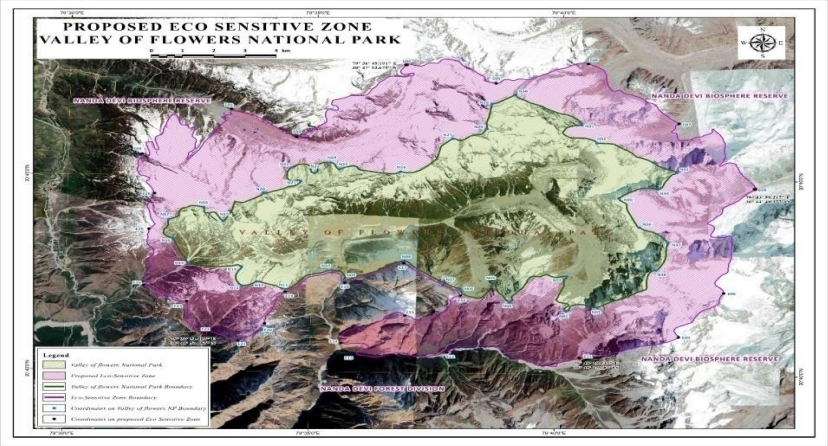
The Nanda Devi and Valley of Flowers National Parks are naturally well protected due to their inaccessibility. The State Forest Department monitors the limited routes that provide access to these parks on a regular basis. Both parks see very little human use, with the exception of some community-based ecotourism that is regulated and facilitated by park management. Since 1983, there has been no livestock grazing within these parks. Mountaineering and adventure-based activities have been prohibited within Nanda Devi National Park since 1983 due to garbage accumulation and environmental degradation caused by such activities in the past. Since 1993, scientific expeditions have been carried out once every ten years to monitor the status of flora, fauna, and their habitats within Nanda Devi National Park. The results of the surveys and time series analysis of remote sensing data show that the status of flora, fauna and their habitats within Nanda Devi National Park has improved significantly. Similarly, studies and annual surveys in Valley of Flowers National Park show that the flora, fauna, and habitats are stable. The National Parks and Reserved Forests in the Nanda Devi Biosphere Reserve buffer zone are both well protected and managed according to wildlife management and working plans.

Orchids are considered as an ecological health indicator. Mandal valley in the district is rich in orchid species, with more than 50 orchid species observed in the area. Orchid conservation centre has been recently inaugurated to attract tourist and livelihood for local people (ANI, 2021).

Recently in the month of August, herbal garden was inaugurated in mana village, Chamoli. The main aim of this high-altitude herbal park is to conserve various medicinally and culturally important alpine species and to do research on their propagation and habitat ecology (ANI, 2021). Thuner tree has also been grown here. The bark of this tree is used for making anti-cancerous

drugs. Environmental Information Service has enlisted major medicinal plants found in the district (ENVIS). These products and many more need to be identified and accorded their due recognition by making them available for natural medicine etc.

Sr. No.	Local Name	Medicinal Use
1	Latjira	piles, cough, asthama, snake bite
2	Maurya Shikha	Skin disease, diabetes, fever
3	Hansraj	Eye ailment
4	Chua seeds	Veterinary disease
5	Gojha	Snake bite, Urinary disorder
6	Jawaridhun	Indigestion, Jaundice, cold
7	Kachnar	Diarrhoea, Indigestion
8	Bhang (Cannabis)	Fever, diarrhoea, skin disease, asthma
9	Bethu	Stomach ulcers
10	Bel	Body pain, burns, eye disease, headache, hair loss
11	Dhatura	Asthma, skin disease, boils, sores



Threats to Forests

- Deforestation, has created immediate shortages of fuel wood and fodder, and also reduced the quantity of drinking water.
- Field observations have indicated that water resources are diminishing, particularly through the drying of springs and small streams on which most village communities depend.
- Uncontrolled fires have also caused tremendous damage to the forest biodiversity. Forest fires occur from March to June, as a result of high temperature, extreme dryness, windy conditions and low humidity in the forest floor.
- The state has implemented development projects and given mining leases that have degraded forestland and also displaced many forest-dwellers or alienated communities'

dependent on forest resources. Such exclusionist strategies have only generated conflicts over natural resources.

Wetlands

The wetlands are the source of many ecosystems and habitats for a variety of species. The wetlands create a unique ecosystem that supports many species simultaneously like aquatic, terrestrial, and human beings. The district has many potential sources and opportunities to harness valuable products using the scheme and start the pilot project. Local stakeholders directly or indirectly depend on the wetland for their income and small-scale business. These businesses can be a great opportunity can be turned into a large-scale production hub using the right approach. The region has a good amount of production of millets and sheep rearing. The region is rich in medicinal plants and trees also. The data collected and analyzed shows the region's production and possible product that can be derived from the raw product. The list of sources and the possible products are mentioned below:

- Apple and peach production is recommended in the region, leading to products like juice and jam.
- Production of lemon is reasonably high, which can turn into the products like pickles and juice.
- Walnut, apricot grows in the district, can be channeled to be sold as natural products.
- The region has many medicinal plants cultivation like kutki, kuth, atis, salam pamja, jatamansi and many more. Production of these plants can be increased by turning nursey and allocated land, and products like drugs and ayurvedic medicine can be derived
- The local people of the district living in the region use animals like himalayan goat and buffalo for dairy products, and also the government has also initiated many schemes like the ganga gay mahila dairy scheme. Also, the people in the district use sheep, which can be encouraged for wool production.
- The trees in the district are supported by wetlands directly or indirectly. Trees like deodar, chir, bet, Lisa, and bamboo are grown in this region, leading to small-scale industry for mat, grass fibre, containers, etc.
- The government can also initiate to support silk cultivation which required intensive water for the process. The wetland in the area can support these processes.

b) Energy

Biomass Energy

The majority of the region is of rural type in Chamoli along with a vast forest cover. However, there is a major chunk of fallow land and also land left uncultivated in the district probably because of the out-migration of the population for employment opportunities. These large chunks of unutilized lands can be brought under plantation programmes for promoting biomass based energy generation, which will not only help in meeting the power needs of the rural areas of the state but at the same time would also generate employment for local communities. The agricultural practices produce crop residue as by-product and pines provide dry biomass to the district which has been recognized by various companies. Companies like Avani Bio Energy working on production of electricity using pine needles as biomass in other districts of Uttarakhand intend to set up biomass energy systems in Chamoli as well.

The state has certain programs running under Bio-energy Scheme such as Bio-Mass Scheme and Pirul Based Energy Scheme which comes under the Bio Mass Energy scheme of the MNRE Government of India.(Policy for power generation from Pirul (Pine Leaves) and other biomass. Although these are not functional in Chamoli but have great potential of being successful in the district.

Solar and Hydel energy

As of Nov 2019, micro hydel projects have been constructed in the district, while Grid feeded Small Hydro Projects are yet to be constructed. Moreover, over 10,275 kilowatt is the proposed capacity for the district.

Improved Watermill: The up-graded watermills of this hilly region are an essential and important critical source of energy in remote areas. These watermills not only provide electricity to small areas but are also used for grinding grains. Up-graded watermill produces power up to 5 KW which is sufficient for electrification of 15-20 families within the diameter of 500 meters. Small Scale Industry Department, Government of India has declared Watermill (Gharat) as Small Scale Industry and State Government has exempted Watermill parts and products from VAT.

Chamoli has total 298 upgraded watermills.

Solar street lights, solar lanterns solar water heating, dish type solar cooker, village electrification through solar energy are installed and many more are proposed to come up in the district. Hence, the district has been doing well in utilization of solar energy.

c) Tourism

Chamoli embraces many important Hindu pilgrimage sites like Badrinath, Hemkund Sahib, Joshimath and the three of the Panch Prayags; Karnaprayag, Nandprayag, and Vishnuprayag, that come as points of interest for the devotees on their pilgrimage tour.

Chamoli also comprises of India's last inhabited village on Indo-Tibet Border called Mana, which has now become a popular place to visit. Several circuits for Mahabharata, Buddhism and adventure/ nature trail may be developed out of all of these places.

- **BADRINATH DHAM**

  Located at a height of 3,133 meters above sea level, the pre-eminent abode of Lord Vishnu is one of the holiest of the holy shrines of Char Dham pilgrimage in India. Starting with Yamunotri, Gangotri and Kedarnath, Badrinath is the last and most celebrated stop in the pilgrimage tour of Garhwal Himalayas

- **VISHNU PRAYAG**

  Vishnuprayag is the site of confluence of Vishnu Ganga (known after this point as Alaknanda) and the Dhauliganga river, Vishnuprayag has an ancient temple called Vishnu

Kund. It is said that sage Narad worshipped Lord Vishnu at this sanctified spot. Visitors find the Kagbhusandi Lake bewitching with its emerald green depths giving it a still surface. Apart from its religious significance, Vishnuprayag is also a popular destination for adventure seekers as it offers trails for trekking and hiking. A few noted treks include the Valley of Flowers, Kagbhusandi and Hemkund Lake.

- **NANDA PRAYAG**

  Nandaprayag is one of the Panch Prayags. Alaknanda River meets Nandakini River here. It is situated 1,358 m asl. The famous temple dedicated to Lord Krishna i.e 'Gopalji Temple' is also situated here.

- **KARNA PRAYAG**

  Karnaprayag is located on the way to Badrinath and is the site of the confluence of two holy rivers Alaknanda and Pindar. It is situated 1451m asl. It is said that Karna of Mahabharata meditated here for many years to acquire the impregnable shield, which made him a formidable warrior on the battlefield. Swami Vivekananda is also known to have meditated here with his disciples. It is the sub-divisional headquarter of district Chamoli.

- **AULI**

  A famous hill station and ski resort, Auli attracts thousands of tourists each year for skiing and other adventure sports. It lies barely 3 km away from the Karcchon village. The place offers a beautiful trek route surrounded by oak and pine trees, with a view opening to the Nanda Devi mountains.

- **HEMKUND SAHIB**

  26 km away from Karchhon, the shrine is dedicated to the 10th Sikh guru, Guru Gobind Singh Ji. Hemkund Sahib is believed to be the place where the Guru was asked by divine forces to take a bath in the chilling lake after a period of intense meditation. The Gurudwara, lying in the vicinity of a glacial lake is surrounded by 7 mountain peaks, rendering it a divine beauty.

- **VALLEY OF FLOWERS**

  A UNESCO world heritage site, it falls in the UNESCO World Network of Biosphere Reserves due to the presence of endemic alpine flowers and rich variety of flora. The diverse area is also home to many rare and endangered Himalayan animal species like the Musk deer, snow leopard, brown bear etc.

- **WAAN**

Vaan is a trekkers paradise, situated at about 2500 m asl. Apart from being a repertoire of nature's beauty, the village is also of keen spiritual importance. The place provides almost a trance-like serenity to the visitor, thus connecting him to the universal energy of the divine.

- **ROOPKUND TREK**

  Another prominent place of adventure and spiritual significance is the Roopkund trek. The mythical story of the lake is as intriguing as the place itself is. It is said that the goddess Shakti, upon her return journey to Kailash was thirsty and thus pleaded her husband, Lord Shiva to quench her thirst. On her request, the lord pierced his trident right across the land, thus giving rise to this glacial lake. Upon seeing her beautiful reflection in the lake, the goddess named the lake as Roopkund.

4) ACTION PLAN DEVELOPMENT

Each project/initiative needs proper planning, prioritization, implementation, monitoring and its resources. Depending on the successes of initiatives, certain targets set should be reached. In a setting where individuals and organizations are responsible for targets in their respective areas of work, scientific method should be deployed to evaluate their performance.

1. Agriculture and Allied

Priority Thrust Areas

1. Development of horticulture clusters (for each major fruit crop such as Apple, Citrus, walnut, comprising about 64% of GCA under fruits) in convergence with MGNREGA and other relevant schemes, keeping in view of the climatic conditions of each fruit crop. Convergence of Uttarakhand Tea Board with MGNREGA is a good model to emulate.
2. Agro-forestry projects in collaboration with Green India Mission, forest department and Van Panchayats can be developed. The forest department can take uncultivated and barren lands on lease from absentee farmers to set up agro-forestry zones and prepare the DPRs under the convergence framework, with detailed techno-economic feasibility and socio-economic and environmental impact analysis.

3. Introduction of payments for ecosystem services to the farmers doing organic/natural farming to ensure long-term sustainability (ecological, economic and social).
4. Ragi, saava, urad, soybean and potato are promising crops in the district. Marketing support and R&D intensification can make these crops more remunerative for farmers.

5. Branding of all agro-products (fruits, vegetables, food grains, oilseeds, etc.) of the district as organic and creation of value-change through an organized system of collection, sorting,

packaging, distributing, processing and selling to the end-users. Primary processing can be set up near the growers, while secondary and tertiary processing can be done at the market places (towns and cities).

6. A new institutional framework need 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.

7. Area under forest is about 60% of the total reported area. Forest-based livelihood activities have the potential for income generation in the district.

8. Agriculture R&D and extension services needs to be reinvigorated and oriented toward sustainable agricultural practices suited to the hill areas in the case of HVCs, horticulture, livestock and agro-forestry.

9. To inculcate interest of rural youth in organic farming e through vocational training in schools /colleges and visit of college going students on KVK farm so that they may the sustainable farm practices, including bio-fertilizers and bio-pesticides, rain-water harvesting and water conservation techniques.

10. Hill agriculture is mostly female-driven. Their empowerment through training and participation in the income generating activities and creating self-help groups is the need of the hour.

2. Forestry

1. Neighboring state Himachal Pradesh has a great forest scheme: 'Van Samriddhi Jan Samriddhi 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. Chamoli 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 centers can be established in each gram panchayat, these collection centers 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 center where industry-local citizen interaction & seminar can happen.

2. Cluster formation is another approach for collective efforts. Apart from medicinal products, Chamoli has seen production of resin, timber, and forest fruits. The locals who are into similar production can come together and have the common production and packaging facility. These clusters can produce high quality resins, forest honey, bamboo-based products, wooden furniture and toys, jam, and pulps, selling directly to the customers.

District government can facilitate emporiums similar to South Indian states (Karnataka, Kerala state emporium), where profit is directly made by the producer. These shops can have subsidized product to foster rural economy.

3. 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, Baidynath, Himalaya, Zandu, and other furniture, timber-based companies.

With great amount of inland water surfaces and dense forests, eco-tourism is another commercial option for this sector. Eco-tourism can include forest trails, National parks, sanctuaries. Orchid conservation center, Herbal Garden can also be important milestones in these tours. These tours will bridge the forest, tourism, and service industry and can help to boost local employments.

3. Wetlands

Management of wetlands has to be an integrated approach in terms of planning, execution and monitoring. Effective tie-ups of trained academicians and professionals, including ecologists, hydrologists, economists, watershed management specialists, planners and decision makers must be linked with local expertise for overall management of wetlands. All these would increase knowledge and understanding of wetlands and evolve more comprehensive and long-term conservation and management strategies.

Spreading awareness by initiating educational programs about the importance of wetlands and forests in local schools, colleges and among the general public in their vicinity. Since their jurisdiction is diffused and falls under various departments like agriculture, fisheries, irrigation, revenue, tourism, water resources and local bodies, it is most important to engage locals in conservation and economic harnessing.

To tackle the problems of deteriorating forests and wetlands we need a multi-dimensional approach:

1. Identification and Inventory

-Space Application Centre of ISRO has already made identification of wetlands on the scale of 1:50,000. They need to re-collect the information on the scale of 1:25,000 to gather precise data of small wetlands. Also, they need to re-collect the data on the scale of 1:50,000 to understand the present scenario and compare it with past wetland data.
-Creating an open-source inventory database.

2. Condition

-Produce regional and national baseline assessments and monitoring programs.

-Data collection of pre and post-monsoon changes in the size of the wetlands.
-Quantification of woods, fish, species (especially endangered species/ indicator species etc.) and valuable goods provided by the wetland ecosystem.
-Measurement of the condition of the wetland like water quality, air quality, soil quality other parameters.

3. Research

-Funding research of sustainable (environmental, economical, social) development, rejuvenation and restoration, vulnerability to climate and other factors.
-Working on successful schemes, like pirul based biomass briquettes etc. which tackle forest fires along with providing fuel and economic value.

4. Reviving and Conservation Plan

- Introduction and protection of broad-leaf and non-timber forest product (NTFP) species e.g. Kaifal and Amla in areas occupied by chir pine to reduce forest fires.
-Making local stakeholders a significant advisors. To document, highlight, apply traditional knowledge to wetland conservation.
- Promotion of silvi-pastoral systems (on highly degraded land and rangeland) using native plant species with high quality and acceptance in the community.
-Formation of the steering committee of the technical experts of the different domains to assess the reviving/rejuvenation plan.

5. Creating Economic Value

-Chamoli has several important medicinal and aromatic plants. These species yield high industrial value (pharmaceutical/ perfumes) and bring livelihood opportunities. With a network of well-coordinated collection centers, and information and quality monitoring support, pharmaceuticals, FMCG etc. companies can be attracted. Through e-tendering system raw materials may be made available locally and companies can also start manufacturing level. Potential companies can be Dabur, vaidynath, Himalaya, zandu, and other furniture, timber-based companies.

-Alternatively produce like resin, timber, and forest fruits, fish etc. can be marketed through cluster emporiums. Common production related services like segregation, weighing, packaging etc. can be made available. District government can facilitate emporiums similar to South Indian states (Karnataka, Kerala state emporium), where profit is directly made by the producer. These shops can have subsidized product to foster rural economy.

-With great amount of inland water surfaces and dense forests, eco-tourism is another commercial opportunity. Eco-tourism can include forest trails, National parks, sanctuaries. Orchid conservation center, Herbal Garden can also be important milestones in these tours. These tours will bridge the forest, tourism, and service industry and can help to boost local employments.

6. Policies

-Wetland protection act following the pattern of Ramsar wetlands.
-Providing some wetland of national importance
-Promoting symbiotic relations between community and forests through Van panchayatas
- Adopting/ promoting successful schemes like Van Samriddhi Jan samriddhi, Van Dhan Yojana etc.
-Promoting a sense of reverence towards nature by increasing the sacred grooves.

4. Energy

The district of Chamoli situated at 1550m above sea level is a home to such natural resources that would make it almost self-reliable in its energy requirements. Among the alternative renewable sources of energy available are biomass, solar and hydel energy.

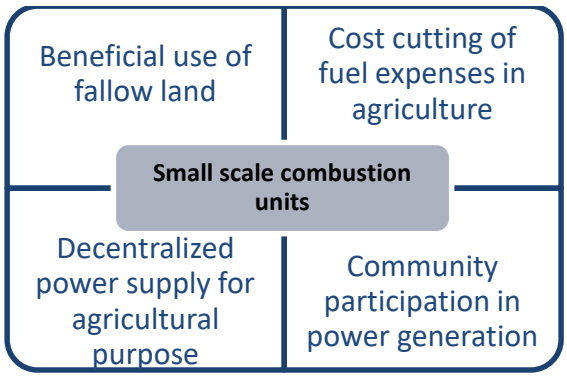


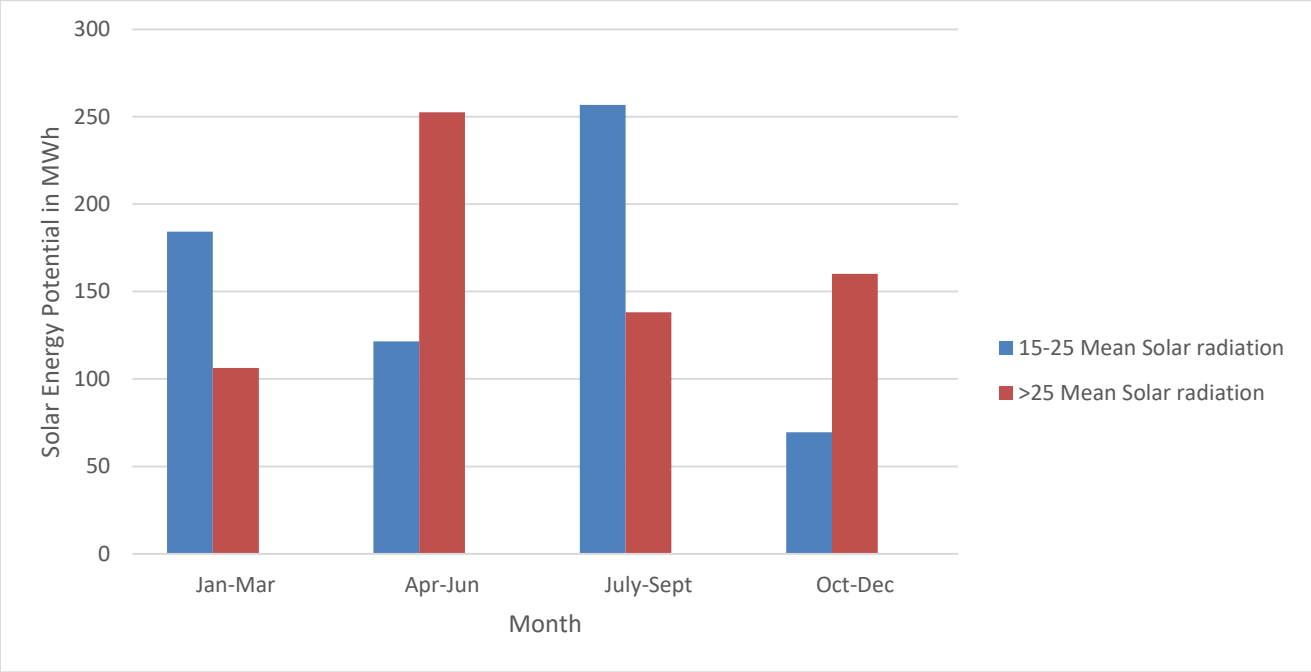
Figure: Benefits of small scale energy plants

These are a great potential source of local livelihood. Also they could create positive feedbacks. Hydel energy harnessed through micro hydel plants etc. can have potentail for fishing. Biomass energy if harnessed well can also prevent forest fires (Pirul based energy), and generate bio fertilizers. Small energy plants can help unburden farmers for energy requirements and provide more sustainable solutions than subsidized power.

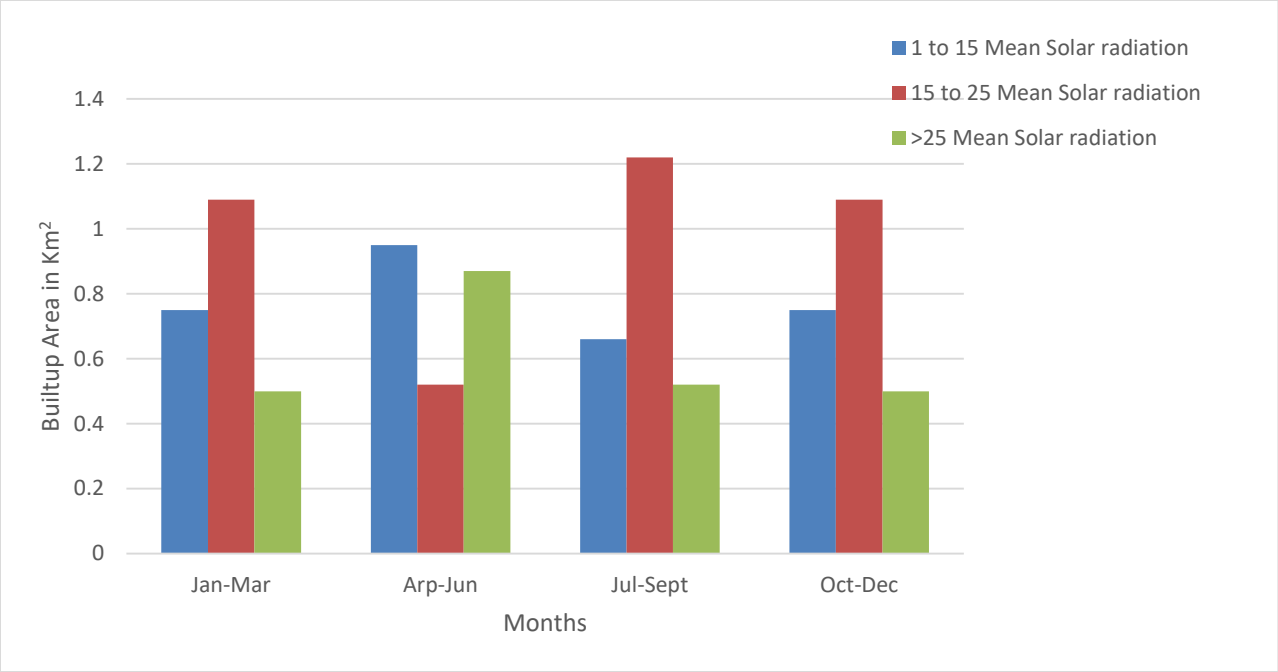
Solar

- The urban area of Chamoli district is still at the nascent stage for using the solar energy. Urban area has **zero commercial power plants** (District Data). Also, some of the urban households are partially dependent on the solar energy. It is urgent requirement for local government for awareness campaign among the people and implementing direct schemes like neighbouring district of Champawat.
- The major built-up structures in Uttarakhand are low-heightened and in horizontally spread, flat rooftops of these buildings could be used as a potential site for solar photovoltaic energy generation. If rooftops with enough insolation are used for the economically viable PV installation setup, the dependency on non-renewable energy sources can be reduced.

Topography and unavailability of flat land has been the biggest obstacle to set up large scale solar PV modules in a hill state like Uttarakhand. Decentralized electrification in hilly areas of Uttarakhand state can be done utilizing a flat rooftop of buildings for solar PV module installation (Mishra, 2020).



Rooftop Solar Energy Potential (MWh) in chamoli,2020



Built up Area under different mean solar radiation range (kWh/m^2/day) in Chamoli, 2020

- As per above analysis urban and rural buildings can be observed and can be approached from the local government for the solar energy promotion (Mishra, 2020).
- 66% of total geographical area of district is non-forest land. Identification of barren and sloppy lands can be done with GIS analysis (District Forest Report).
- Chamoli is hilly area with agriculture and forest product-based economy. The district currently has many small-scale businesses and clusters of local agro-based industries (e.g. herbs, fruits, frozen tulsi, fruit juices, and jams) and handicraft/ cottage industries (e.g. shawls, woollen, and hosiery). These clusters can have huge cost saving and extra income through grid based solar schemes like **Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahaabhiyan, Mukhayamantri Saur Swarojgar Yojna etc.**
- **Decentralised off-grid** community based Solar Water Heating Plants and Solar energy plants can reduce total cost replacing fossil fuels and timber-based fuels.

BIOMASS ENERGY

The energy production using biomass can be done in various ways using crop residue, forest waste, animal waste, etc. The important thing is the easy availability of any of these resources which depends on the geographical location of the area. Chamoli is situated at 1,550 m above sea level which naturally increases its pine production. The pine trees shed pine needles in large amounts which can be used for the production of energy using gasification technology. So the best suited technology for the district is the gasification of pine needles along with this combustion plants can be set up on household level to utilize the crop residues and animal waste.

Pirul Based Energy Scheme which comes under the Bio Mass Energy scheme of the MNRE Government of India should be taken up by the authorities. The scheme should have provisions involving the locals along with the children. The locals would get employment along with good quality charcoal which is produced during the process and children would get the practical knowledge.

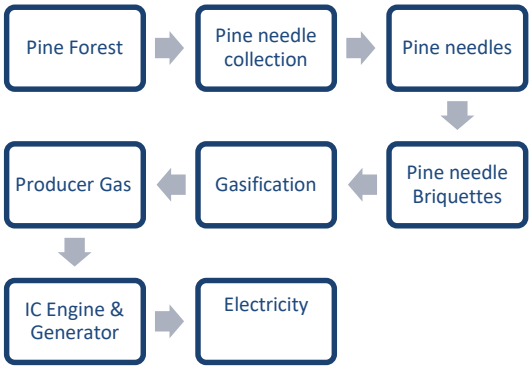


Figure: PIRUL based energy flow chart

The combustion technology utilizing the crop residue and animal waste can be started in the fallow lands available. The whole system of high pressure boilers and turbines can be set up in the fallow lands to which the raw material would be provided by farmers having lands in nearby areas. The electricity produced from this setup could be used by farmers for different agricultural operations. Such small units can be set up according to the availability of the resources. This way the land left unutilized could be used up for a fruitful purpose. The unit which would be set up would provide employment opportunities and could be used by the youth for experimental purposes hence increasing the chances of improvement in technology. This of course would solve the problem of waste management as well.

This way there will be an overall development of the district making it self-reliant. Also there will be reduction in ecological degradation caused by pine leaves. On the whole environment friendly renewable energy will be harnessed enhancing the socio economic development of the district.

Among steps to promote clean energy taken by the government are:

Stamp duty exemption for Biomass: If the power generation unit is set up in private land, the developer shall be exempted from payment of stamp duty for registration of documents. If the developer used this land for other purposes, the amount of stamp duty shall be recovered from the developer under Policy for Energy Generation from Pine Litter and Other Biomass-2018.

Pine Needles Based Biomass Gasifier "A Pilot Project" The total area of Pine Forest in reserve forest in Uttarakhand is about 3.43 Lakh Hectare. These Pine forests in Uttarakhand produces about 20.58 lakhs tonnes of dry biomass (pine needle) annually. Since carriage of pine needles is not easy, if we consider the carriage of pine needles from the pine forests near to habitation or near the road head, approximately 40% of the biomass can be transported. Hence we can hope to get about 8.23 lakh tonnes every year, and about 0.80 lakh tones pine needles are available in Van Panchayat and Civil Soyam Forest. The quantity of lantana can be taken as 2 QTLs/Hectare in reserve forest and in protected areas such as Rajaji National Park and Corbet National Park. The

average yield of lantana is about 10 QTLs/Hectare. In this mind, UREDA had organized a workshop on prospective uses of pine needles for energy application in September 2010.

New technologies such as high temperature proton exchange mechanism fuel cells for biogas can be a game changer. It is ideal for distributed operations and can provide energy along with heating solutions with a combined efficiency of 75%.

Hydropower

Uttarakhand Jal Vidyut Nigam Limited undertakes small hydropower construction only after conducting a detailed survey (s), investigation (s), and engineering, including cost optimization of various options. This necessitates the collection of hydrological and geological data, as well as their synthesis, in order to arrive at the most cost-effective engineering solution. Safe designs should be adopted based on previous geology, metrology, and topography experience, and where tunnels replaced necessary power channels.

5. Tourism

Chamoli has several tourism benefits and if planned well can become the hub for adventure and religious tourism.

1. Promote Adventure tourism: Auli is a popular skiing destination in India and it offers a brilliant site for skiing and paragliding because of its glittering slopes and clean environment. Dotted with apple orchards, oaks and deodars, Auli is a popular hill town with numerous ski resorts situated amidst the Himalayan range. Located at 2800 meters above sea levels, it is home to mountain ranges of Nanda Devi, Mana Parvat and Kamat Kamet. Many religious destinations are also scattered around Auli. It is believed that Shankracharya had blessed Auli with his visit. This place can be developed more to attract young crowd. Organize skiing and paragliding competitions and develop training centers where tourists can spend some vacation and enjoy these sports. Specially since summers stretch for long months these types of sports and adventure tourism can be a bliss for domestic tourists as well. Given the Covid pandemic the resorts and hotels should be audited and constantly monitored to ensure adherence to government protocol for maintaining hygiene and wellness of tourists. A paradise for adventure lovers and nature buffs, another spot is Brahmtal Trek which is nothing short of fascinating and thrilling. Hidden away in the secluded region amidst the ridge, the lake provides an ideal destination for the intriguing trekkers. This followed by rafting on Upper Alaknanda River is exhausting and tiring but more than that it is exhilarating and rewarding. The chase on the wild rapids and the ever-changing landscape of gorges and dense forests pumps up the excitement level to maximum. The first action plan is to develop an adventure tourist circuit including Auli, Brahmtak Trek and Upper Alaknanda River. Get endorsement from celebrities such as Bachendri Pal, Krushnaa Patil, and Malavath Purna for the adventure, safety and thrill in these place. Again start with the National National Alpine Skiing Contest as was done in 2019. This will bring sponsors, sportsmen as well as tourists to this place and improve the regional economy. Partner with Adventure Tour Operators Association of India

to organize Girl's Ski mountaineering event (as done in Gulmarg in Kashmir this year) ensuring women safety and health. Finally, involve the Indian Olympic Association (IOA) and the Winter Games Federation of India (WGFI) to organize National Winter games in Auli as it provide good resort facilities.

2. Promote Religious tourism: the second action plan is to develop religious tourist circuit including Gopeshwar, Gopinath temple, Kalpeshwar, Rudranath, and Badrinath. Three of the immediate action plans should be (1) to create awareness about the religious and historical importance of these places, (2) work with ministry of railways and IRCTC to develop affordable and safe tourism packages covering these places in the post-pandemic scenario and (3) promote these places under the "incredible India" campaign. Most people are aware of char-dham yatra but stories such as “The Gopinath temple was built by Raja Saggar and the king saw a cow giving milk on Shiva Lingam daily and he constructed a temple there” also need to be told as it gives new perspectives. Visiting religious places is a very well-known coping mechanism for stress and negative sentiments that have arisen due to the Covid-19. Therefore, this circuit can be a huge opportunity for that. Rudranath is a totally secluded and remote location where one can experience solace and peace amongst silver mountain peaks. This has not been looked at developing large meditation and wellness centers to attract tourists. This can be the center place of spiritual and philosophical enlightenment. Very few people have tried or know about the Garhwali and Kumauni cuisines such as aloo ke gutke, gahat, chainsoo and kaapa which are available in these regions. The hotels and restaurants should make special menu by including and promoting such local cuisines (apart form regular Chinese, continental etc.) to give different tourism experience. One should also start online Darshan of Gopeshwar, Gopinath temple, Kalpeshwar, Rudranath, and Badrinath for those who cannot travel either due to pandemic fear or other health reasons for minimal charges. This way we can also control huge crowd to avoid any new wave of Covid-19. Use the technology such as laser shows to educate tourists about the religious and historical sentiments of the place through which we can maintain social distancing also and give unique experience to tourists.

3. Infrastructural support needed: Kedarnath witnessed the worst during the 2013 floods. MP Thapliyal, chairman of Kedarnath-Badrinath Temple Committee, asserts: “The temple area has the capacity to accommodate less than 5,000 people, but the Kedarnath shrine is receiving footfalls of 20,000-25,000 pilgrims almost every day” (see reference: https://www.downtoearth.org.in/blog/natural-disasters/uttarakhand-may-be-staring-at-another-disaster-65243). This is a serious issue. The place is predisposed to earthquakes, landslides, flash-floods, cloudbursts, avalanches, as well as droughts. We have to look for sustainable tourism practices and even if that means keeping a check on the number of tourists today, we need to look into those in order to survive. There is a need to keep a check on deforestation, building of roads and tunnels through mountains, and sand mining on river beds. The state government has to look into the report on the Uttarakhand Disaster in 2013 released by the Ministry of Home Affairs. In August 2018 the High Court of Uttarakhand had instructed the state government to limit the

number of tourists to 200 per day visiting alpine meadows or sub-alpine meadows or bugyals and directed to remove all the permanent structures within three months from these areas. This needs to be followed strictly. Recently, Maccaferri completes the construction of reinforced soil wall on NH-58 passing through Lambagarh, Uttarakhand (see reference: https://www.financialexpress.com/infrastructure/landslide-mitigation-work-completed-alongside-badrinath-road-in-uttarakhand-all-you-need-to-know/2265290/). Government should support the company and provide all necessary clearances to develop such road covering all the necessary tourist circuits to avoid any landslides in future affecting tourism and economic activities. Although road construction is underway and needed to promote tourism the government should ensure the caveats released by the Ministry of Science and Technology in June 2010 under the heading 'Green Road Construction' such as (see reference: https://science.thewire.in/environment/the-char-dham-road-project-poses-a-grave-threat-to-himalayan-ecosystems/): 1. Environmental impact assessment to be made mandatory for the construction of all state and national roads and expressways of more than 5 km length, including in the extension and widening of existing roads and excluding inter-village roads. 2. Road construction should provide for the treatment of hill-slope instabilities resulting from road-cutting, cross drainage work and culverts, using bio-engineering and other appropriate technologies.

Projects Proposed and CEL framework

As per the CEL model (Conservation, Economic value and Livelihood), most acceptable projects in Ganga fall into 4 types. For any developmental activity to be sustainable, proper balancing of these 3 (CEL) parameters is necessary. In Chamoli district they map out in the following manner:

For the **type 1** activities (High on economic/livelihood parameter, but low on conservation), one must find ways to exploit high Economic values while innovatively reducing the negative impacts. Economic activity is imperative to arrest the rampant outmigration. Activities like agriculture and horticulture figure here.

- organic forms of agriculture. The economic value and livelihood value of this is much higher than chemical farming while reducing negative impacts. Mechanization and reductionist approaches have caused us to move away from this. Better marketing and supporting activities (collection, grading, segregation etc.) are needed here.
- Horticulture and Commercial Plantations make the idea of food processing and more livelihood more attractive in the district. Land laws and laws against felling of trees are an impediment here. We need a case-based mechanism of approvals here with a supportive state machinery.
- Collection centers for wild plant species/ forest goods is needed. Often over-usage causes harm to the forests. An effective strategy here would be to firstly, formalize them, so that measures to conserve may be out in place. One way is by replant species of mushrooms etc. taken. Another is to shift collection works to different forests/ different patches and allowing them to rejuvenate.

- Poly House based cultivation in very high altitudes. Since people living there also need important crops that don't grow there, controlled temperature cultivation is the way to go.

For the **type 2** activities (Mixed effects on conservation, high economic value), ways to monetize them is important. The mixed effect on these activities must be either offset by more or by limiting the activities as a whole or by better innovative techniques. Example in eco-tourism in several important destinations had to be stopped due to littering done there. An innovative approach would be to promote eco-friendly packaging only in the district so that littering in the eco sensitive zones can be managed.

- Companies for food processing, making products like juices and pickles etc. Some others like patanjali, zandu, himalaya, dabur, vaidyanath etc. to use medicinal plants and create economically viable products and livelihoods. Formal companies are much easier to regulate and monitor. Some of these companies may not act in accordance with environmental norms and must be let go.
- Winter Olympics and important winter sports can be a huge boost for tourism. But organizing such an event may at times cause environmental issues. Some of these games may be dropped and those which are organized need to be managed well.

Projects which fare high on conservation and livelihood (**Type 3**), need maximum resource provisioning. Livelihood providing activities like wetlands conservation and rejuvenation, agro forestry have several positive externalities. Some of them help conserve monumental natural heritage while some other save lives lost almost annually to landslides. Some others help tackle climate change all while providing livelihood.

- Agro forestry. Covering the mountains and hills and allowing for a future timber industry to develop
- Rejuvenation of wetlands, digging up ponds in certain regions etc. which can hold rain water.
- livestock, promoting wool, silk, dairy, fisheries in sustainable fashion, provisioning areas as pastures with indigenous grasses for sustaining livestock. More livestock can help soil carbon increase while creating future (supply led) demands for wool etc.
- increasing herbal gardens in the district. These help in educating people about herbs and also provide a future possibility of economic use.
- Make available SBLP (SHG Bank linking Program) through NABARD etc. by organizing women into SHGs since most work in here is female labor based.

Given the impact on nature and high livelihood possibility, we need maximum resource provisioning in these projects. This can be done through the route of MNREGA and other schemes. With support from the state, these activities can then become self-sustaining or evolve alternate usages.

Finally, the activities that are low in economic value, livelihood, but high conservation (**type 4**). Like energy and bio diversity management. We must look to adopt a holistic long term vision. These activities will make a base for developing future type 1, 2 and 3 activities. All investments made here will yield bounty for future economic activities.

- Energy is a basic requirement and with proper supply in the hills other development projects can fly. Emphasis must be on decentralized models. These can prove resilient to

outages in some places and also have lower environmental damage. High Temperature Proton Exchange Membrane based fuels cells for clean electricity from biogas

Micro hydro energy projects can power both fisheries and factories near them

- If conservation works are done well, then eco-tourism and medicinal plants availability will be more profitable. Biodiversity management hence must be done in a scientific manner. Managing keystone species etc. is a technical work with low economic returns but if done well can help sustain and improve eco-tourism. People love to visit the famous lion prides of Africa which have become famous due to documentaries. Making them famous was a difficult job which took a lot of time and money.
- To perform conservation activities better we need to mark our natural heritage (wetlands and forests) better through Remote sensing, set quality standards and baselines and then promote research. Collecting local traditional knowledge is also an important aspect for sustaining and involving the local populace.

5) Recommendations

Multi-sectoral recommendations for Chamoli

- Given high labour outflow, empowerment of women through training and organizing self-help groups. Involving them in relevant projects is necessary for any success.
- A new institutional framework need to be set up at the district level where the concerned departments provide advisory services. KVK, Agrometeorological Field Unit Ranichauri (AMFU Ranichauri) etc. should make information available in simple language. This decision support system can help all involved stakeholders.
- Rich medicinal, aromatic, nutritional plants should be utilized for industrial uses. Cultivation, rather than wild-harvest, of threatened valuable medicinal plants, may support the traditional uses while also protecting wild populations.
- Since apple is the dominant horticultural crop in the district, an apple-based food processing industry can be established in the district.
- Favoring micro hydro project over mega projects. Multipurpose hydropower plants may augment fishing, boating, water supply, irrigation and power supply.
- Work on the suggestions of Ministry of Science and Technology report and the Ministry of Home Affairs before starting any new construction project (power plant, roads, tunnels etc).
- Mandating that tourist are coming with RTPCR negative report and the staff and guides are vaccinated.
- It is recommended to promote eco-tourism in the region. As the region is fragile, we must limit the number of visitors. The money generated could help maintain the hotspots.
- Given difficulties in transport and lack of power, bio-toilets may be promoted for public use.
- Restoration of the water bodies through MNREGA. This can be done by recharging old ponds and lakes through rain water harvesting and watershed management. Steps like water quality testing and quantification of water bodies at regular intervals.
- Organic farming and scientific fishery to lower the pollution of the wetlands. Switching to coarse grains (millet mission), oats, and pulses will reduce water stress and also have better market value. Barah Anaaj – a system of farming 12 mixed food grains is popular here. Uttarakhand is sought to be promoted as an "organic state".

Agriculture & Allied Activities-

- 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 due to various reasons. The departments can do large scale horticulture and agro-forestry activities under MGNREGA convergence. These departments can set up horticulture and agro-forestry zones and prepare the DPRs under the convergence framework, with detailed techno-economic feasibility and socio-economic and environmental impact analysis. Wire fencing of these zones can be done by the departments to protect the crops and plantations from the wild animal. Such fencing would be more cost-effective as compared to fencing of individual farmers' land.

- 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 supply chain network.
- Agriculture production in the district has high level of variability and is vulnerable to natural factors. To protect farmers' livelihood and income, compulsory and free crop insurance should be provided.
- Increasing livestock productivity through increasing green fodder availability and improving nutritional status. It is recommended to promote animal husbandry, wool and silk industry in the area. This provides a boost to the economic growth of the local people.
- Enhancing productivity by rejuvenating senile orchards.
- Organizing Farmers as FPOs and ensuring procurement timely procurement.
- Promoting Contract/Corporate Farming –by involving Retail houses.
- Setting up juice plants for Apple and IQF units for fruits, vegetables.
- The majority of the area of Chamoli district lies in the upper Himalayan region with high altitudes. About 80% of the area has very steep slopes. Thus promoting protected cultivation in polyhouse or greenhouse can help grow high value crops.
- The gravity-fed drip irrigation system can be a useful solution for irrigating water-scarce areas of the district. It can provide uniform discharge throughout the area spread on several terraces with varying elevations and irregular shapes, enhancing crop yield.
- Most of the farm implements and machinery used by the farmers in the district come from plain areas, which are not optimized for use in the hills. Farmers should be suggested for the use of modified and advanced farm implements, which would be helpful to enhance their crop yield.

Forests-

- Promote success stories like Balkhila Model Forest. Quickly trying to scale them to otherlocalities. Under the **Balkila Model Forest** IUCN has implemented a range of activities towards increasing community resilience to climate change including **solar, biogas, watermill revival,spring revival, afforestation, agroforestry, organic farming and livelihood** diversification.

- **'Fiber Reinforced Plastic'** biogas units are **prefabricated digesters** which make quality control as well as installation much easier and simpler than conventional masonry models of biogas digesters. It is a cattle dung-based system and on average produces 3-4 hours/day of clean cooking fuel. Apart from meeting the daily household fuel needs, this also helps to reduce the pressure on forests, while strengthening local livelihoods. Biogas also has climate and health benefits.

- Provide Wildlife Corridors and Connections Between Green Spaces. This safeguards against both, the shrinking of gene pool among animals and man wild conflicts

Energy

Hydro power

- Climate change and arrival of grid power has led to the closure and abandonment of large number of mills. These traditional watermills, though low in efficiency, have proven to be the best examples of clean energy generation at small scale.

  IUCN India recently revived a watermill at Village Mandal in the Himalayan state of Uttarakhand. It was kept in mind that the technology should be low cost, simple to adopt, and beneficiary adequately trained during installation of the mill. The improved watermill has high efficiency steel turbine, pipe jets, steel shaft and water regulation mechanism to adjust to low and high river discharge. The water conveyance structure is strengthened with concrete channel, flood gate and a sedimentation tank to protect it against high floods and siltation

Solar

- There is little to no awareness among urban residents about the solar energy schemes. It is important for local government to infiltrate these schemes through local campaigns and advertising success stories. Many urban rooftops have the potential for solar water heating and grid based solar plants. If the citizen understood the costing and subsidy benefits, people might start using Solar energy.
- Local government can approach rural businesses and clusters and can explain these schemes to be independent. The roofs of food processing units and small business can be covered under solar roof top scheme phase-II, this grid connection can provide lucrative income.
- Farmers in the remote area can be fully self-sustainable through **Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahaabhiyan.** The barren lands can cultivate the energy and can make good amount of money for sharing this electricity.
- In the state of Gujarat, authorities have placed solar panels along the irrigation canals, providing two important benefits: 1. Saving Evaporation Loss 2. Electricity generation for neighbouring villages (BBC , 2020). This same provision can be applied to the streams and canals in the district.
- There is also potential for solar panel and solar heater manufacturing industry. This can fulfil local demand of solar energy hardware and also developing skilled employment.

Tourism-

- Promote the local Kumauni and Garhwali food, and local art forms (wooden carvings and miniature paintings from Garhwali gharana) to support local artisans and economic growth along with developing tourists attractions
- Should work with the Kedarnath/temple board to keep a check on the number of tourists vising all the main temples per day.

- Focus on developing health centers, hospitals and elderly care centers in the region as mostly elder people do char dham yatra and oxygen levels are usually low at those heights and any cases of flu like infections also can be tackled properly
- Collaborate with the Indian Olympic Association (IOA) and the Winter Games Federation of India (WGFI) to develop sports and adventure tourism in the region.
- Develop technology driven training centers and sports complexes in the region for promoting Chamoli as the hub for winter sports and snow/water based sports in the country

6) Discussion during the Report Presentation

- Chamoli district has numerous water bodies.
- Natural Farming is being promoted by the State Government.
- The district has a great opportunity for eco-tourism and a plan will be taken up in future DGC meetings. The beautification of Badrinath temple is being taken up under the PRASAD scheme.
- 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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7) Appendix

Table 5: Land use/ Land cover statistics classes of Chamoli district
Source: GIS data

LULC classes	Area(km^2) Year-2010	Area(km^2) Year-2020
Snow and glacier	3616.52 (45.99)	4168.45 (53.00)
Crop land	600.10 (7.63)	605.13 (7.69)
River/stream	55.31 (0.70)	43.66 (0.56)
Dense forest	1530.00 (19.45)	1547.93 (19.68)
Open forest	1175.58 (14.95)	1130.18 (14.37)
Barren	887.03 (11.28)	369.19 (4.69)
Total Geographical area	7864.54 (100)	7864.54 (100)

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	1,58,309	10	57,78,27,850	433370887.5	86674177.5	25	3466967.1
Buffalo	Manure	43,191	15	23,64,70,725	177353043.8	35470608.75	25	1418824.35
Sheep	Manure	1,02,353	1	3,73,58,845	28019133.75	5603826.75	25	224153.07
Goat	Manure	81,612	1	2,97,88,380	22341285	4468257	25	178730.28
Pig	Manure	348	2.5	3,17,550	238162.5	47632.5	25	1905.3
Poultry	manure	24,772	0.1	9,04,178	678133.5	135626.7	25	5425.068

Assumption: manure availability=everyday, moisture content= 80%

Source: https://vikaspedia.in/energy/energy-production/bio-energy/biogas

Table 1 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	620	1.5	930	651	15	553.35	800	442680
Wheat	straw	33630	1.5	50445	35311.5	30	24718.05	800	19774440
Sugarcane	Bagasse	0	0.33	0	0	80	0	750	0

Crop data source: http://data.icrisat.org/dld/src/crops.html

Table 6: Trends in Land-use Pattern in Chamoli (as % of 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	851764	59.42	1.21	0.02	0.07	8.35	7.19	3.27	16.61	3.87
2010-11	851764	59.42	1.08	0.01	0.01	8.35	7.19	3.27	16.61	4.06
2011-12	851764	59.42	1.08	0.39	0.01	8.35	7.19	3.27	16.61	3.67
2012-13	851764	59.42	1.29	0.03	0.20	8.48	7.15	3.18	16.41	3.84
2013-14	851764	59.42	1.29	0.07	0.21	8.48	7.15	3.18	16.41	3.79
2015-16	851764	59.42	1.29	0.02	0.12	8.48	7.15	3.18	16.41	3.93
2016-17	851764	59.42	1.29	0.03	0.12	8.48	7.15	3.18	16.41	3.91
2017-18	851764	59.42	1.36	0.08	0.12	10.66	1.96	5.61	16.94	3.85

Source: Prepared from District Statistical Handbooks of Chamoli

2.3.2 Trends in Operational Land Holdings

In Chamoli district, total number of operational holdings has increased from 44915 in 20201-11 to 47049 in 2015-16, a net increase of 4.75 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%. A majority of land holdings in the district are marginal and small. These categories of holding together constituted 93.08% 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 (Nos.)
Chamoli	2010-11	74.64	16.67	7.17	1.48	0.04	44915
	2015-16	75.68	17.40	6.01	0.87	0.04	47049 [4.75]
Uttarakhand	2010-11	73.65	17.24	7.10	1.90	0.12	912650
	2015-16	74.78	16.89	6.59	1.64	0.10	881305 [-3.43]

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

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

Fertilizer/ Year	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Nitrogen	2.28	2.74	2.28	2.16	2.22	2.63	2.57	1.89	2.03
Phosphorous	1.45	1.72	1.50	1.42	1.46	1.33	1.46	1.93	0.91
Potassium	0.36	0.36	0.06	0.10	0.25	0.00	0.04	0.04	0.02
Total	4.09	4.82	3.84	3.68	3.68	3.96	4.07	3.25	2.97

Source: District Statistical Handbooks

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

Crop/Year	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Rice	23.51	23.47	23.22	23.99	24.20	24.11	24.37	23.28	22.41
Wheat	28.67	28.94	28.44	28.72	29.51	28.91	29.13	28.57	29.26
Barley	3.28	3.64	4.12	4.06	3.09	3.53	2.60	3.82	3.85
Maize	0.41	0.37	0.42	0.39	0.38	0.39	0.47	0.48	0.42
Ragi	20.43	19.05	20.23	20.14	20.19	18.80	19.10	20.27	19.59
Saava	5.47	6.36	6.03	7.60	5.53	6.19	5.83	6.60	6.55
Total Cereal	86.87	88.54	88.14	89.76	87.69	87.30	87.66	88.01	87.30
Urad	0.81	0.69	0.72	0.93	0.68	1.18	1.00	0.96	1.07
Masoor	0.17	0.06	0.17	0.09	0.07	0.07	0.12	0.23	0.13
Matar	0.02	0.05	0.07	0.02	0.17	0.05	0.16	0.01	0.47

Arhar	0.22	0.22	0.22	0.26	0.31	0.41	0.38	0.30	0.40
Total pulses	4.60	4.08	4.07	4.20	4.53	5.39	5.00	5.10	5.06
Total Food Grains	91.47	92.62	92.21	93.96	92.23	92.69	92.66	93.11	92.36
Mustard	0.96	1.26	1.21	0.87	0.84	1.19	1.15	1.08	0.79
Soyabean	0.79	0.82	1.00	0.99	0.79	1.15	1.00	0.83	1.21
Total Oil seeds	1.81	2.18	2.27	1.91	1.67	2.41	2.19	1.98	2.04
Potato	5.86	4.26	4.34	3.19	4.88	3.97	3.90	3.63	4.17
Net Sown Area	66.39	65.49	66.08	65.44	66.37	68.71	70.52	67.73	66.71
Gross Sown Area (ha)	49645 (100)	52853 (100)	47370 (100)	49952 (100)	48669 (100)	46717 (100)	47408 (100)	49189 (100)	49212 (100)
Cropping Intensity	150.62	152.68	151.33	152.81	150.67	145.54	141.80	147.64	149.89

Source: Estimated from District Statistical Handbooks

Table 11: Variability in Area, Production and Yield of Principal Crops (2009-10 to 2017-18)

Crop/ Year	Area			Production			Yield		
	Av	SD	COV	Av	SD	COV	Av	SD	COV
Rice	11571	454	3.93	15262	1111	7.28	13.29	0.86	6.48
Wheat	14164	555	3.92	19083	2194	11.50	13.47	1.27	9.45
Barley	1744	259	14.86	2360	468	19.83	13.40	0.97	7.25
Maize	203	17	8.44	255	110	43.03	12.41	4.77	38.43
Ragi	9681	476	4.92	14587	1129	7.74	14.95	0.42	2.82
Saava	3061	372	12.14	4180	1111	26.59	14.34	0.69	4.80
Total Cereals	43087	1819	4.22	57784	4605	7.97	13.43	0.73	5.42
Urad	437	80	18.20	440	164	37.33	9.75	2.11	21.59
Masoor	60	28	46.49	43	19	44.49	7.37	0.94	12.80
Peas	56	71	126.83	43	54	125.93	6.98	1.22	17.44
Arhar	147	36	24.44	75	23	30.44	5.07	0.42	8.33
Total Pulses	2285	206	9.04	2143	428	19.99	9.21	1.20	12.98
Total Food Grains	45372	1765	3.89	59926	4603	7.68	13.22	0.72	5.41
Mustard	509	90	17.65	291	126	43.32	5.59	2.06	36.86
Soyabean	466	70	14.96	472	68	14.34	9.88	0.56	5.66
Total Oil Seeds	1004	109	10.85	771	113	14.69	7.53	0.92	12.21
Potato	2081	392	18.86	20861	11016	52.80	107.67	20.73	19.26
Source: District Statistical Handbooks									

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	2016-17	2017-18
Rice	11.83	14.13	13.23	14.22	12.93	12.79	12.9	13	14.56
Wheat	12.54	14.35	14.69	14.67	13.87	11.39	11.67	13.82	14.2
Barley	13.25	15.01	14.09	13.89	13.91	13.12	11.57	12.77	13.02
Maize	6.44	8.91	8.97	8.97	8.96	17.67	17.65	16.88	17.25
Ragi	14.44	14.86	14.59	15.52	15.33	14.43	14.78	15.21	15.38
Saava	13.87	14.08	14.21	15.01	12.89	14.54	14.49	15.16	14.78
Total Cereal	12.37	13.59	13.53	14.40	13.56	12.53	12.79	13.75	14.32

Urad	7.87	8.71	6.58	8.5	9.77	11.4	10.6	10.73	13.6
Masoor	5.88	6.80	6.07	8	8.5	8.43	7.52	7.54	7.55
Matar	3.75	7.14	7.25	7.5	7.45	7.45	7.4	7.45	7.45
Arhar	4.76	4.66	4.37	5.17	5.09	5.14	5.25	5.78	5.42
Total Pulses	7.24	8.78	8.20	8.48	8.85	10.54	9.61	10.47	10.68
Total Food Grains	12.11	13.38	13.30	14.16	13.33	12.42	12.62	13.57	14.12
Mustard	4.02	4.63	4.75	4.7	4.75	5.81	9.54	8.54	3.58
Soyabean	10.24	9.98	9.98	10.2	10.2	10.75	9.17	9.16	9.27
Total Oil Seeds	6.66	6.53	7	7.51	7.28	8.09	9.25	8.54	6.92
Potato	118.78	102.95	148.8	75.2	96.71	122.39	95.69	99.56	108.97
Source: District Statistical Handbook									

Constructed Micro Hydel Project (Till Nov. 2019)				
District	Name of Scheme	Capacity (in kW)	Electrified	
			No. of Villages	No. of Hamlets
Chamoli	**Milkhet**	**100**	**4**	**1**
	Wan	**50**	**1**	**3**
	Choting	**100**	**6**	**2**
	Sarma	**100**	**2**	**4**
	Bank	**100**	**5**	**3**
	Niti	**25**	**1**	**0**
	Gamshali Bampa	**50**	**2**	**0**

Identified Micro Hydel Projects of UREDA		
District	Name of Project	Proposed Capacity (kW)
Chamoli	Chupladagad	400
	Jethagad	250
	Bomanbera	200
	Ghuni	200
	Meeng gadera	200
	Milikhet-2	200
	Nandakini	2000
	Sufaligad	2000
	Talwariwan	600
	Rupganga	1000
	Molagad	400
	Pranmati	1800
	Garur Ganga	400

	Uttaron	1000
	Bansbagar	100
	Bhadragad	150
	Sartoli	100
	Tharali-2	700
	Saikot	150
	Sorigad	100

of	Wetland Type	Altitude	Sub – Watershed Basin	Vegetation Type
Bedni Kund	Tarn	3,556 m asl	Nandakini	Moist Alpine
Roop Kund	Tarn	4,763 m asl	Nandakini	Moist Alpine
Hum Kund	Proglacial	5,617 m asl	Nandakini	Moist Alpine
Bhekkal Tal	Tarn	3,053 m asl	Pindar	Moist – Sub Alpine
Brahma Tal	Tarn	3,235 m asl	Nandakini	Moist Alpine
Hemkund Sahib	Tarn	4,204 m asl	Bhiundar gadh – Alaknanda	Moist Alpine
Bara-Dhara Sem Complex	Marsh Meadow	4,032 m asl	Alaknanda	Moist Alpine
Satopanth Tal	Proglacial	4,359 m asl	Alaknanda	Moist Alpine
Tara Tal Complex	Tarn	5,407 m asl	Saraswati - Alaknanda	Dry Alpine
Shyahi Kund	Proglacial	5,532 m asl	Saraswati	Dry Alpine
Doodh Tal	Proglacial	5,484 m asl	Saraswati - Alaknanda	Dry Alpine
Dev Tal	Proglacial	5,455 m asl	Saraswati	Dry Alpine
Raatpathar Tal	Tarn	5,641 m asl	Saraswati	Dry Alpine
Vasudhara Tal Complex	Glacial	4,691 m asl	Raikana-Dhauli Ganga	Dry alpine
Gyaldhung Tal	Glacial	4,914 m asl	Dhauli Ganga	Dry Alpine
Nandi Kund	Tarn	4,369 m asl	Madhmaheshwar gadh	Moist Alpine

Table 4: Livelihood Status in Chamoli (2017)

Employment Status			Sectoral distribution of employment			Distribution of workers by Skills		
	Chamoli	Uttara-khand		Chamoli	Uttara-khand	Skill	Chamoli	Uttara-khand
Self-employed	59.6	56.9	Primary	62.9	39.3	Low	25.8	24.9
Regular	14.4	24.2	Secondary	14.9	25.4	Medium	68.3	65.5
Casual	26.0	18.9	Tertiary	22.2	35.3	high	6.0	9.6
Total	100	100		100	100	Total	100	100
Poverty status	27.5	15.6	Inequality (Gini Coeff.)	0.316	0.308			

Source: Uttarakhand Human Development Report

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

Livestock	**Category**	1998	2003	2007	2012	2019
Indigenous Cattle	Total Male	88755	91107	92862	67525	53751
	Total Female	78527	81981	85953	80700	78414
	Total	167282	173088	178815	148225	132165
Exotic Cattle	Total Male	2766	8748	1390	2011	1053
	Total Female	3239	6619	3352	8073	12407
	Total	6005	15367	4742	10084	13460
Total Cattle	Total Cattle	173287	188455	183557	158309	145625
Buffalo	Total Male	7869	7863	7973	1197	685
	Total Female	41167	47290	43684	41994	37237
	Total	49036	55153	51657	43191	37922
Sheep	Total Indigenous Sheep	48118	37581	53536	97696	73747
	Total Exotic Sheep	6641	8070	4621	4657	1670
	Total Sheep	54759	45651	58157	102353	75417
Goat	Total Male	-	-	-	20281	22576
	Total Female	-	-	-	61331	74285
	Total	78159	80648	81612	81612	96861
Pig	Total Indigenous Pig	240	302	339	314	287
	Total Exotic Pig	49	72	205	34	0
	Total Pig	289	374	544	348	287
Total Livestock		360552	372815	386959	389951	-
Total Poultry		11112	18864	15018	24567	-

Table 14: Process of Migration (First Migration) in Chamoli (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
Chamoli	75.5	18.9	4.4	1.0	0.0	0.0	100
UK	72.1	18.0	6.6	2.6	0.1	0.6	100

Source: Uttarkhand Human Development Report

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

Sl No	Block	Scheme	No of Groups	No of Farmers in Groups			
				Total	Average	Median	SD
1	Dasholi	PKVY	54	2823	52.28	50	8.77
		Namami Gange	19	1587	83.52	92	36.35
2	Dewal	PKVY	33	1339	43.19	42	8.39
		Namami Gange	5	255	51	55	16.78
3	Gairsain	PKVY	74	3857	52.12	50	11.27
		Namami Gange	-	-	-	-	-
4	Ghat	PKVY	37	1863	50.35	50	1.80
		Namami Gange	-	-	-	-	-
5	Joshimath	PKVY	27	1307	48.41	50	11.62
		Namami Gange	12	623	51.91	44	24.77
6	KarnaPrayag	PKVY	92	4509	49	50	8.53
		Namami Gange	19	1208	63.58	45	34.97
7	Narayanbagar	PKVY	53	2260	42.64	44	9.16
		Namami Gange	22	1282	58.27	59.5	20.98
8	Pokhari	PKVY	60	3015	50.25	50	1.70
		Namami Gange	7	440	62.85	57	13.84
9	Tharali	PKVY	53	2553	49.01	50	3.31
		Namami Gange	21	1510	71.90	60	37.90
10	District	PKVY	483	23526	49.01	50	8.60
		Namami	105	6905	65.76	60	31.70
		Total	588	30431	52.02	50	16.76

Source: Compiled from https://pgsindia-ncof.gov.in/