DRAFT REPORT

DISTRICT ENVIRONMENTAL PLAN

(As per the Hon'ble National Green Tribunal (NGT) vide order O.A. no. 360/2018 dated 26.09.2019)

RUDRAPRAYAG

G.B. Pant National Institute of Himalayan Environment (GBPNIHE), Kosi-Katarmal, Almora, Uttarakhand

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PREFACE

Hon'ble National Green Tribunal (NGT) vide order, dated 26/09/2019 in O.A. No. 360 of 2018 filed by Shree Nath Sharma Vs. Union of India and Others directed that Central Pollution Control Board (CPCB) shall facilitate the District Magistrates in preparation of the District Environmental Plan (DEP) by placing a model plan on its website. This model plan may be adopted as per local requirements by all districts under the supervision of the District Magistrate. The said order also directs that the Department of Environment in respective states should collect district plans to prepare State Environment Plan (SEP), which shall be monitored by respective Chief Secretaries of the State by 15/12/2019. Based on State Environmental Plans, CPCB and Ministry of Environment, Forest & Climate Change (MoEFCC) shall prepare a National Environmental Plan (NEP), under the supervision of Secretary, MoEFCC and Chairman, CPCB.

There are diverse environmental issues that address our key responsibilities to the community and its surrounding environment. As a set of target, fourteen areas by Hon'ble NGT and one more - plastic waste by Government of Uttarakhand were included under the district plan. These 14 areas were regarding compliance to rules for solid waste including legacy waste, bio-medical waste, Construction & Demolition waste (C&D), hazardous waste, Electronic waste (E-waste), polluter stretches, non-attainment cities, Industrial clusters, the status of Sewage Treatment Plants (STPs) and re-use of treated water, the status of Common Effluent Treatment Plants (CETPs)/ Effluent Treatment Plants (ETPs), ground water extraction/ contamination and re-charge, air pollution including noise pollution, illegal sand mining, and rejuvenation of water bodies. In addition, plastic waste was also assessed based on consultative workshops with the state government including State Pollution Control Board (SPCB).

The present environmental plan describes the status quo of 15 thematic areas and sets out strategies to mitigate their impact on different environmental parameters and human health. It briefly touches upon the basic need for bringing in mountain perspective in developmental planning. Implementation of this plan based on selected indicators will resolve different environmental issues. Also, it will meet compliance of different departments within a district. It will also allow a variety of environmental opportunities associated with different activities to be further undertaken from a view point of sustainable development. We hope this document will act as a noble reference for various stakeholders interested in sustainable development planning for the Rudraprayag district. Moreover, it will help to develop comprehensive understanding of the environmental planning process in view of socio-economic and financial situation of the district.

Date:

Principal Investigator, Co-Project Investigators & Project staff

ACKNOWLEDGEMENT

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ABBREVIATIONS

AMRUT	- Atal Mission for Rejuvenation and Urban Transformation
APL	- Above Poverty Line
AR6	- Sixth Assessment Report
As	- Arsenic
BaP	- Benzo (a) Pyrene
BMWMIS	- Biomedical Waste Management Information System
BPL	- Below Poverty Line
BRO	- Border Road Organization
C	- Carbon
C_6H_6	- Benzene
C&D waste	- Construction and Demolition waste
CACMP	- Catchment Area Conservation and Management Plan
CBMWTF	- Common Bio-Medical Waste Treatment Facility
Cd	- Cadmium
CD	- Check Dam
CETP	- Common Effluent Treatment Plant
CFL	- Compact Fluorescent Lamp
CGWB	- Central Ground Water Board
CH_4	- Methane
CHC	- Community Healthcare Centre
CK	- Chal Khal
CO	- Carbon monoxide
CO_2	- Carbon dioxide
CPCB	- Central Pollution Control Board
CPHEEO	- Central Public Health and Environmental Engineering Organisation
Cr	- Chromium
CSC	- Community Sanitary Complex
CT	- Contour Trench
Cu	- Copper
DDT	- DichloroDiphenylTrichloroethane
DPR	- Detailed Project Report
DPRO	- District Panchayati Raj officer
EEE	- Electronics and Electrical Equipment

EEMI	- Electricals & Electronics Manufacturing in India
ENVIS	- Environmental Information System
ETP	- Effluent Treatment Plant
E-waste	- Electronic waste
F	- Fluoride
FPZ	- Flood Plain Zones
FSI	- Forest Survey of India
FSSM	- Faecal Sludge and Septage Management
GBPNIHE	- Govind Ballabh Pant National Institute of Himalayan Environment
GDP	- Gross Domestic Product
GIS	- Geographical Information System
GPS	- Global Positioning System
HCF	- Health Care Facility
HFL	- Highest Flood Level
ICIMOD	- International Centre for Integrated Mountain Development
ICT	- Information and Communication Technology
IEC	- Information, Education and Communication
IHHL	- Individual Household Latrine
IPC	- Inter-Personal Communication
IPCC	- Intergovernmental Panel on Climate Change
IRAP	- Integrated Rural Accessibility Planning
ISO	- International Organization for Standardization
ISWM	- Integrated Solid Waste Management
IWRM	- Integrated Water Resources Management
MDWS	- Ministry of Drinking Water and Sanitation
MGNREGS	- Mahatma Gandhi National Rural Employment Guarantee Scheme
MMT	- Million Metric Tons
MoeFCC	- Ministry of Environment, Forest and Climate Change
MoUHA	- Ministry of Urban and Housing Affairs
MPCC	- Medical Pollution Control Committee
MRF	- Material Recovery Facility
MSW	- Municipal Solid Waste
MTPD	- Metric Ton per Day
NA	- Data Not Available/ Not Applicable

NATCOM	- National Communication
NAAQS	- National Ambient Air Quality Standards
NCAP	- National Clean Air Programme
NCEPC	- National Committee on Environment Planning and Coordination
NGOs	- Non-Governmental Organizations
NGT	- National Green Tribunal
NH	- National Highway
NH_3	- Ammonia
Ni	- Nickel
NITI	- National Institution for Transforming India
NO_2	- Nitrogen Dioxide
NP	- Nagar Panchayat
NPP	- Nagar Palika Parishad
NRLM	- Namami Gange, National Rural Livelihood mission
NUSP	- National Urban Sanitation Policy
ODF	- Open Defecation Free
OSS	- On-Site Sanitation
O_3	- Ozone
Pb	- Lead
PCC	- Pollution Control Committee
PHC	- Primary Healthcare Centre
PIBO	-Producer, Importer and Brand Owner
PM	- Particulate Matter
PPP	- Polluter Pays Principle
PT	- Percolation Tank
PUC	- Pollution under Control
PWD	- Public Works Department
RBM	- River Bed Minerals
RoHS	- Restriction of Hazardous Substances
RSM	- Rural Sanitary Mart
RTRWH	- Rooftop Rain Water Harvesting
RWD	- Rural Works Department
SBM-G	- Swachh Bharat Mission-Gramin
SDG	- Sustainable Developmental Goals

SHGs	- Self Help Groups
SLWM	- Solid and Liquid Waste Management
SO_2	- Sulphur Dioxide
SPCB	- State Pollution Control Board
SSMG	- Sustainable Sand Management Guidelines
STP	- Sewage Treatment Plant
TSDF	- Treatment Storage and Disposal Facilities
UKPCB	- Uttarakhand Pollution Control Board
ULB	- Urban Local Body
UNDP	- United Nations Development Programme
UNEP	- United Nations Environment Programme
UREDA	- Uttarakhand Renewable Energy Development Agency
WHO	- World Health Organization
µg	- Microgram

EXECUTIVE SUMMARY

Rudraprayag district is one of the smallest district in the state of Uttarakhand. It has got enormous religious significance and is visited by thousands of pilgrims every year. This bring forth challenge to the district authority and other departments to oversee the influx of increasing waste, pollution levels etc. in the district. To efficiently manage such development, adequate environmental planning is required. Moreover, it must be in consonance with the needs of future.

In view of analysing the current status and furnishing a comprehensive plan to mitigate the environmental deterioration, GBPNIHE was assigned with the task to prepare district Environment plan. Detailed deliberations were carried out to devise the action plan focusing explicitly on the following thematic areas which includes:

- ***Waste Management Operations:*** The ULBs of Rudraprayag district has done well in primary waste management operations including source segregation and door to door collection. Scientific waste management through linkage with third party has helped manage the dry waste in a very effective way.

  Other wastes such as domestic hazardous waste, Electronic waste are currently not streamlined in the waste management operations of the district. Quantification and segregation of such waste has become necessary keeping in mind the health, ecological and economical aspects.

  The solid waste generation in the district is expected to increase 4-10 MTPD per day in coming decades. Hence, new waste management infrastructure or augmentation of current infrastructure is desired in near future.
- ***Biomedical Waste Management:*** More than 150 healthcare facilities (including public, private etc.) are available in the district but only few of them have been authorised by Uttarakhand Pollution control board. Moreover, scientific management of Bio-medical waste is hard to find as only few HCFs have linkage with CBWTF. Most of the HCFs are using deep burial method for the disposal of biomedical waste.
- ***Construction and Demolition Waste Management:*** There are no designated dumping site for the disposal of C&D waste generated in the ULBs of the district. Although dumping zones have been established by National Highway authority for the muck disposal of under construction All Weather Char Dham highway. Some amount of C&D waste is reused by filling the low lying areas.
- ***Waste water Management***: At present six storm surge water treatment facilities are operational in the district. A STP is proposed in Nagar parishad. Rudraprayag and is currently in planning phase. Rest of the district still relies in conventional Septic Tank+Soak pit for waste water disposal.

- ***Air and Noise Pollution:*** The status quo of air quality is unknown in the district due to lack of automatic or manual air quality station. Vehicular pollution and forest fires are in rise in the district and they can be a potential source of air pollution in the district. These facts would be ascertained by setting up an air quality monitoring station, which has been proposed by Uttarakhand Pollution Control Board.
- As such, noise pollution is not a big issue in the district except during festivals and public events. Sign boards has been setup in the periphery of silent zones. However, a regular monitoring drive must be launched to check noise pollution levels in different areas of the district.
- ***Surface and Groundwater Management:*** Alaknanda and Mandakini are the major rivers in the district and maximum population resides in the watershed of these two rivers. A committee has been in charge for ensuring the water quality, control of idol immersion, flood plains protection etc. of the rivers. Multiple departments are working under different government sponsored schemes for recharge of surface and ground water.
- Almost one third of the total geographical area of the district has been identified for artificial recharge. Under this, construction of structures such as Contour trenches, Chal-khal, check dams etc. has been proposed.
- ***Mining activity:*** Sand mining activities are prevalent in the district owing to the large flood plains of Alaknanda and Mandakini river. Minimal area has been affected by the illegal mining in the district. Penalties have been charged for illegal mining operation subsequently. Although, the designated mining areas meets the environment clearances conditions and works under the consent conditions of Uttarakhand Pollution Control Board.

The execution of this management plan will require the integration and co-operation of the people, private and public stakeholders of Rudraprayag district. This plan aims at reducing the risk on the human health and environment with a target of sustainable development.

INTRODUCTION

Establishing a link between environmental degradation, poverty and economic sustainability has always been a challenging task before the planners. The world's poor are significantly prone to natural disasters pertaining to the fact that in many cases their livelihoods are directly dependent on the natural resources. Human welfare is closely associated with the health of the environment. Around the world, 24 percent of deaths can be traced back to avoidable environmental factors (WHO, 2018). People are in direct need of clean air to breathe, freshwater to drink and suitable places to live in that are free from pollutions including toxic substances and hazards. The 2030 agenda for Sustainable Development Goals (SDGs) and its 17 Goals adopted by world leaders define a blueprint for future development trajectory to all the nations with a focus on poverty eradication, environmental sustainability, peace and harmony (Anonymous, 2018; WHO, 2018; Azash and Thirupalu, 2017). Recently, Intergovernmental Panel on Climate Change (IPCC) released a Report on "Climate Change 2021- The Physical Science Basis" as a part of IPCC's Sixth Assessment report (AR6). The facts presented in this report raised a crucial red flag regarding global temperatures that have already risen by about 1.1 ºC from pre-industrial times and has warned that 1.5 ºC threshold is likely to be breached before 2040 *(the stated objective of 2015 Paris Agreement, the international architecture to fight climate change, is to limit temperature increase to within 2 ºC from pre-industrial times)* (IPCC, 2021). For the Indian perspective, the report says that waves and humid heat stress will be more intense and frequent in 21st century (IPCC, 2021). Changes in monsoon precipitation are also expected as both annual and summer monsoon precipitation are projected to increase (Krishnan et al, 2020). In regard to the Himalayan context, the area is one of the most fragile mountainous regions of the world. Hence, it is susceptible to changes in Environmental conditions and ecology (Krishnan et al, 2020). These mountains are considered to be the Water tower of South Asia, as major rivers of the Indian sub-continent originate from the Himalayan Mountains. However, the area has become a global hotspot since the past two decades in view of environmental degradation. The indirect impact is also seen in the glaciological aspect of these mountains (Eriksson et al, 2019). Almost, 500 million people of South Asia are dependent upon the health aspect of the Himalayan ecosystem. In India, the Himalayan Mountain Chain directly serves a national interest because of working as a guard in view of defense purpose, unique ecosystem in view of permanent snow cover and incessant sources of water and biodiversity hotspots. The people in downhill slopes and in the Indo–Gangetic plains realize its significance in many more aspects in view of sustainable development. A prerequisite for such sustainability is ecological audit in areas, which at once would apprise about the present environmental issues and a strategy to meet the targets for the future (Sandhu and Sandhu, 2015).

Uttarakhand being a crucial chunk of the Himalayan regime is utmost vulnerable to environmental degradations and risks. About three fourth of the state's population is rural, therefore their livelihoods are almost dependent on natural resources (Raj, 2015). The traditional customs and traditional knowledge of the local people of Uttarakhand tend to be sustainable and are in harmony with the natural ecosystem. However, these traditional customs and traditional knowledge are often overlooked as sometimes reckless development of roads, infrastructure, and environmental degradation takes precedence over the traditional ecological knowledge. The recent data on SDGs indices released by NITI Aayog shows that the state is one of the top gainers with increase in overall index by 8 points. However, a lot is needed to be done in terms of the indicators related to Climate Action *(SDG, 13)* (Chopra, 2014). The tragedy of ecological governance in most parts is that it remains trapped in Environment-Development Binary. In contrast, the people of Uttarakhand had in past shown with movements such as the Chipko Andolan (1953), which gave an idea of human well-being sensitive to forests, mountains, and water bodies (Sarkar, 2018).

The art of establishing balance between economic development and sustainable development is known to many, but how it is implemented in the ground is known to few. We need to devise a strategy to break this trade off so that a mutually beneficial situation is achieved for the environment and society (Messerli et al, 2019). Environment plan is a prerequisite to understand how the social, political and economic factors are affecting the environment considering development. Environmental planning begins in India in early 1970s after Human Environment Conference at Stockholm held by United Nations which led to the formation of National Committee on Environment Planning and Co-ordination (NCEPC*)* (NATCOM, 2012). Subsequently, then the Ministry of Environment and Forest (MoEF) was formed in mid 1980s by Government of India., realizing that the conservation of nature and its sustainability is a basic requirement for sustaining healthy life on globe. The key purpose of this plan is therefore to implement and devise programs intended to reduce pollution loads in different natural components, suggest mitigating or minimizing impacts, conserving and protecting the environment which could be considered together as a base for sustainable development (UNDP, 2015; Gaur, 2008).

FUNDAMENTAL PRINCIPLES OF ENVIRONMENT PROTECTION

(Judgments of the Hon'ble Supreme Court of India)

Sustainable Development

Hon'ble Supreme Court has recognized the principle of sustainable development as a basis for balancing ecological imperatives with development goals. In rural litigation and entitlement Kendra, *Dehradun Vs. State of U.P.*, the Supreme Court 1985 was apprised with the problem of the mining activities in the limestone quarries in Dehradun-Mussoorie area (Azash and Thirupalu, 2017; Anonymous, 2014). This was the first case of its kind in the country involving issues relating to environment and ecological balance and brought into sharp focus the conflict between development and conservation. In this case, the Supreme Court emphasized the need for reconciling development and conservation in the larger interest of the country (Anonymous, 2014; Sahu, 2014). Furthermore, it was realized that the necessary condition for achieving sustainable development is ecological security, economic efficiency and social equity (Rajaram, 2005).

Precautionary Principle

The emergence of precautionary principle marked a shift in the international environmental jurisprudence– a shift from assimilative capacity principle to precautionary principle. Basically, it is a principle which ensures that a substance or activity posing threat to the environment is prevented due to adversely affecting it, even if there is no conclusive scientific proof lining that particular substance or activity to the environment damage (Kriebel et al, 2001). In *Vellore Citizens Welfare Forum Vs. Union of India*, it was alleged that the untreated effluent being discharged by tanneries in Tamil Nadu was entering into the river, agricultural fields and was significantly polluting the water. Justice Kuldip Singh *(Known to be Green Judge)* observed that "even otherwise once these principles are accepted as a part of the Customary International Law, there would not be difficulty in accepting them as a part of domestic law (Venkat, 2012). It is almost accepted proposition of municipal law, that the rule of customary international law, which are not contrary to the municipal law shall be deemed to be incorporated in the domestic law and shall also be followed by the courts of laws of the country. According to this special principle, the burden is on the person wanting to change the status quo to show that the actions proposed will not have any adverse effect, the presumption operating in favor of environmental protection (Singh, 2000).

Polluter Pays Principle

Polluter Pays Principle (PPP) has become a popular slogan in recent times. *"If you make a mess, it's your duty to clean it up".* It should be mentioned that in environmental law, this principle doesn't refer to Fault". Instead, it favours a curative approach which is concerned with repairing ecological

damage (Kriebel et al, 2001). The Hon'ble Supreme Court held that as per the Polluter Pays Principle, "once the activity carried on is hazardous or inherently dangerous, the person carrying out such activity is liable to make good the loss caused to any other person by this activity irrespective of the fact whether he took reasonable care while carrying on his activity. While applying the principle of polluter pays, the Supreme Court later expressed the view that compensation to be awarded must have some correlation not only with the magnitude and capacity of the enterprise but also with the harms caused by it (Kriebel et al, 2001).

Public Trust Doctrine

The public trust doctrine primarily rests on the principle that certain resources like air, sea water and forests have such a great importance to the people as a whole that it would be wholly unjustified to make them a subject of private ownership. The said resources being a gift of nature, they should be made freely available to everyone irrespective of the status in life. This doctrine came up 2014 for consideration in the *M.C. Mehta vs. Kamal Nath* (Anonymous, 2014). Though the Supreme Court did not specifically refer to the Doctrine of Public Trust directly, in many cases they have given impact on this doctrine implicitly (Azash and Thirupalu, 2017). Traditionally, the doctrine of public trust was applied only for protection of access to the common for public benefit, now the doctrine is being applied even to prevent over-exploitation of the environmental components (Azash and Thirupalu, 2017).

Public Liability Insurance

The Public Liability Insurance Act 1991 has been enacted with the objective of providing immediate relief to the victims of accidents that might occur while handling hazardous substances. The owner who has control over handling of hazardous substances is required under the act to pay specified amounts to the victims as interim relief based on "No-Fault" liability. The expression 'Handling' is defined widely to include manufacture, trade and transport of hazardous substances. *Accidents by reason of war or radioactivity are excluded from the scope of the Act (*Azash and Thirupalu, 2017). The principle of absolute liability was propounded in case of *MC Mehta vs. Union of India* with the primary question regarding the extent to which industries engaged in hazardous and inherently dangerous industries can be held liable. This principle was further reaffirmed in the Indian Council for *Enviro Legal Action vs. Union of India* in which it was held that industries will be absolutely liable to the harm caused to villages due to pollution caused due to soil and underground water. Hence, these are bound to take remedial measure to improve the situation *(*Azash and Thirupalu, 2017).

ENVIRONMENT MANAGEMENT SYSTEM (ISO 14001:2015)

An environmental management system helps organizations identify, manage, monitor, and control their environmental issues in a holistic manner. ISO 14001 is an internationally agreed standard that sets out the requirements for an environmental management system (Da, 2015). It helps organizations to improve their environmental performance through more efficient ways of resource use and reduction of waste. Other ISO standards that look at different types of management systems such as ISO 9001 for quality management and ISO 45001 for occupational health and safety, all use a high-level of structure. This means that ISO 14001 can be integrated easily into existing ISO management systems. ISO 14001 includes the need for continual improvement of an organization system and approach to environmental concern (Da, 2015). It is suitable for organizations of all types and sizes, let they be private, or not-profit organisation or governmental. It is desirable that an organisation should consider all environmental issues relevant to its operations such as air pollution, water and sewage issues, waste management, soil contamination, climate change mitigation and adaptation, and resource use efficiency (Ferronato and Torretta, 2019).

DISTRICT PROFILE

The Rudraprayag district is located in the state of Uttarakhand in India. It shares boundary with Uttarakashi and Chamoli, in the South it is bounded by the district of Pauri Garwal, in the East lies the district of Chamoli, in the West lies the district of Tehri Garhwal (Fig. 1). It is connected with other districts of Kumaon Region, Garhwal region, national and the state capital with series of National highways (NH 58, NH 107, NH109.The nearest airport to Rudraprayag district is at Jolly Grant Air Port Dehradun, about 160 km from Rudraprayag. The nearest railway station is at Rishikesh and Haridwar is well connected by trains from all major cities in India such as, Delhi, Lucknow, Mumbai etc.

The headquarters of the district is at Rudraprayag existing at the holy confluence of the rivers Alaknanda and Mandakini. Rudraprayag is one of the Panch Prayags of Alaknanda river. The Shiva and Jagdamba temples are situated in the district which have a great religious importance for our countries people. Total area Rudraprayag district is 1984 km2 as intimated by the office of Survey General of India. The complete region is blessed with enormous natural beauty, places with great religious importance, lakes and glaciers.

Internationally known Shri Kedarnath temples is situated at north in the district. This is a Hindu temple dedicated to Lord Shiva built by Pandavas and revived by Adi Sankaracharya and it is one of the twelve Jyotirlingas, the holiest Hindu shrines of Shiva.

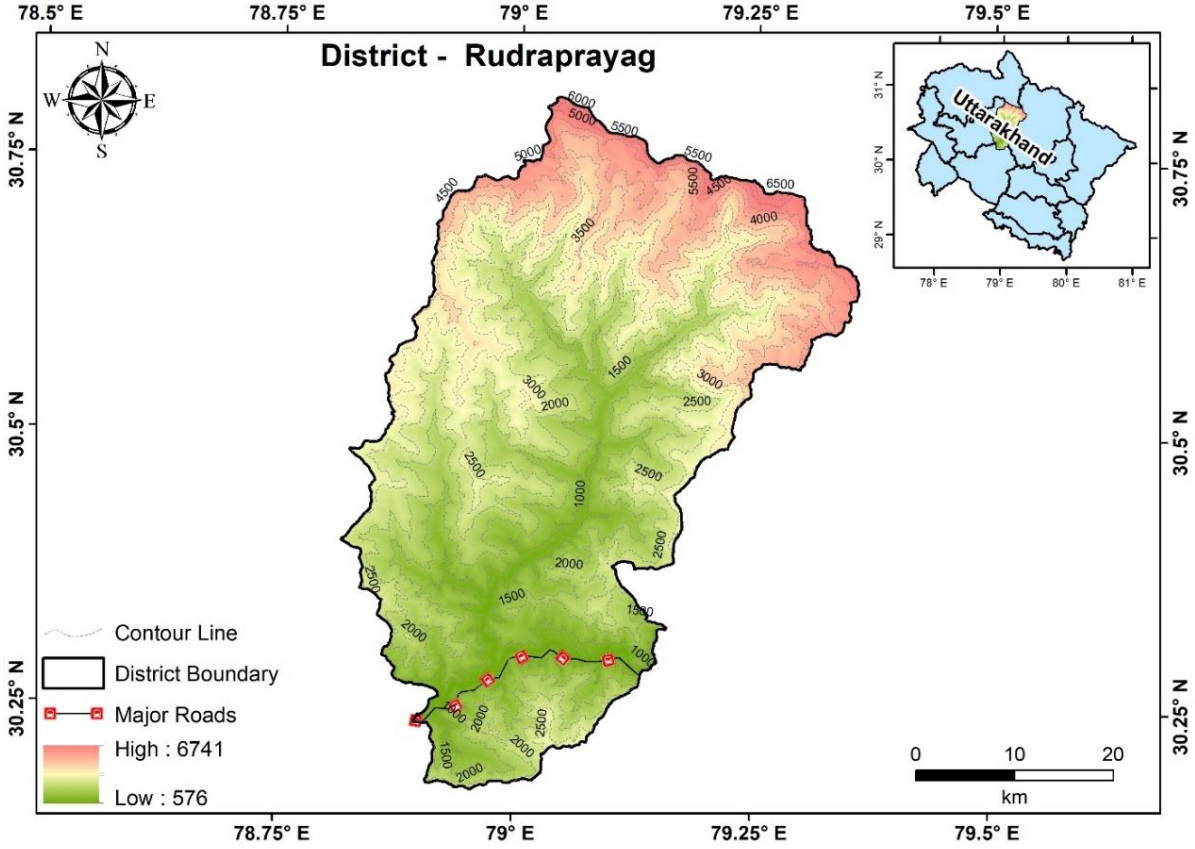


Fig. 1 Location and salient features of Rudraprayag district

District at a Glance

Table 1 and 2 represents the geographical aspect, population data and administrative setup of Rudraprayag district.

Table 1. District at a glance

Geographical Location	
Latitude	$30^0$19'N - $30^0$49'N
Longitude	$78^0$49'E - $79^0$21'13"E
Geographical Area	1984 km^2
Average elevation of district Headquarter	895m
Population Data (2011 census)	
Total Population	242285
Male Population	114589
Female Population	127696
Population density	122
Decadal Population growth rate (2001-2011)	6.53%

Overall Literacy rate	81.30%
Male literacy	93.90%
Female literacy	70.35%
Sex Ratio	1114
Urbanised area	0.64%
Rural area	99.36%

Source: District Census Handbook 2011 and District Survey Report 2016

Table 2. Administrative divisions

Tehsils	04
Blocks	03
Nyay Panchayats	27
Village Panchayats	339
Total census villages	688
Municipal councils	01
Nagar panchayats	03
Cantonment boards	--

Source: District Census Handbook 2011 and District Survey Report 2016

Topography

Geographically Rudraprayag district may be divided into two major units- the high denudational mountains and the river valleys, which are fed by numerous perennial streams (Table 3 and 4). The southern part of this district has a comparatively wide and mature topography with gentle slope and deeply dissected valleys. The northern part has comparatively youthful topography. Moranious plains, glacial valleys, river terraces, structural valleys, lineament, fault and thrust are the other geomorphic units commonly observed in the entire Rudraprayag district. This district lies with an elevation in between 500 m to 7000 m above mean sea level.

Table 3. Altitudinal Zones in Rudraprayag District

Ranges	**Major Peaks**	**Elevation (m)**
Gangotri Mountain Range	Chaukhamba III	6974
	Kedarnath	6940
	Chaukhamba IV	6854
	Bhartekunta	6578
	Sumeru Parbat	6350
	Mandani Parbat	6193
	Bhagirathi Parbat IV	6193
	Dudhatoli	3114

Central Himalayan Mountain Range	Nagtibba	3022

Source: *District Survey Report, Rudraprayag (2018)*

Table 4. Major River Systems in Rudraprayag District

River System	Origin	Tributaries
The Alaknanda River System	Alkapuri Glacier, near Badrinath, Chamoli	Mandakini, Nandakini, Dhauliganga, Pindar, Bhagirathi etc.
The Mandakini River system	Chorabari Glacier, Kedarnath	Vasuki Ganga, kaliganga, Madhyamaheshwar Ganga
The Vasuki Ganga River System	Basuki Tal, near Chor Gamak glacier, Kedarnath	------
The Madhyamaheshwar Ganga River System	Jaggi-Bedula	------

Source: *District Survey Report, Rudraprayag (2018)*

Climate

Climate is highly depended on elevation and the district has a wide variation in elevation. So, the weather patterns of Rudraprayag are characterized by tropical upland, sub-tropical monsoon and sub-arctic type. Severe winter and comparatively higher precipitation are the major characteristics of northern part in this district. Four major seasonal changes are found throughout the year. Such as, i) Cold winter (December to February), ii) the hot weather season (March to May), iii) Southwest monsoon season (June to September), iv) Post monsoon season (October to November). January is the coldest months when cold waves in following the western disturbances often leads to the conditions and the temperature goes down below freezing points. Then temperature continuously increase till the months of June-July when temperatures vary in between 10°c to 34°c.

Rainfall

August is usually the wettest and rainiest month which accounts for about 75% of the annual rainfall. The relative humidity is high during monsoon season generally exceeding 70% on the average and the driest part of the year is the pre monsoon period when humidity may drop 35% except the certain high stations at the time of afternoon. The whole district receives an average rainfall of about 1485 mm (Groundwater brochure of Rudraprayag district, 2011), which predominantly occurs in the rainy season pertaining to the fact that the 70% to 80% of the annual rainfall happens during the months of June to September (. Winter precipitation is usually derived essentially from the western disturbances and frontal cyclones along the Polar front.

Table 5. Distribution of rainfall received by different parts of district.

Part of the district	Annual average rainfall received (mm)
Northern Part	1995
Southern Part	1220.18
Central Part	1750.9

Groundwater

The district Rudraprayag is mainly occupied by Himalayan Mountain ranges and around 50% of the area is perennially covered under snow. Hence there is no scope of ground water development in this area. However, at lower reaches there is scope of ground water development. For this, micro level hydrogeological investigation is required along with favourable physiographical set-up can help to develop ground water by hand pumps (Groundwater Report Rudraprayag, 2011).

Besides, there are number of natural springs which can be utilized to fulfil the need of drinking and irrigation water. For sustainability of these springs, small surface water reservoir can be developed at suitable locations on higher level. Ground water may be developed in valleys areas by constructing the reservoir, large diameter dug wells and shallow tube wells. These techniques will not only provide surface water availability but will also help in recharging the aquifers. Rain water harvesting structures and other suitable groundwater recharge structures like gullying plugs, checking dams, gabion structures can be constructed so that the yield of the handpump is sustained round the year (Groundwater brochure of Rudraprayag district, 2011).

Forestry

On the basis of species composition, structure, habitat and physiography forests of the district were classified into four types: i) Temperate Forest, ii) Temperate mixed forest, iii) Sub-tropical forest and iv) Sub-tropical mixed forest. As much 58% of the total area of the district is covered by forest (Table 6). The district is mostly covered by temperate forests and partially by the sub-tropical forest. Temperate forests are dominant forest types of the district which mostly found in the upper ridges and around the valleys. The subtropical forests located in the lower valleys with southern slopes and are generally sparse forest type of the district. These forests are useful for socio-economic and environmental point of view.

Table 6. Forest cover of Rudraprayag district.

District	Geographical Area	Very Dense Forest	Mod. Dense Forest	Open Forest	Changes as of 2017-2019 assessment
Forest Area of Rudraprayag District (km^2)	1984	252.00	580.00	310.17	1.17

Source: *FSI 2019*

Flora and Fauna

Flora

The region being at a significant range of elevation is home to rich species of plants and flowers, which are full of various colors and fragrances. The state flower of Uttarakhand (Brahma Kamal) flourishes in the high Himalayan regions of the district. Valuable fuels and buildings wood trees include Semel, Sarasu, Dhak, Briquette, Baanj, Chid, Cedar, Khadik, Tune, Surai Kail, Papadi, Mauru, Angu, Reetha, Walnut, Bedu, Gainthi, Timla, Hariz, Paniya, Kattha, Kachnar etc. Table 6 indicates the type of vegetation/forest found in different elevations. The alpine and sub alpine zones are considered as the most natural adobe of the largest number of medicinal plants. *Aconitum heterophyllum* (Atis), *Picrorhiza kurrooa* (Kutki), *Bergenia ciliata* (Vajradanti), *Hedychium spicatum* (Kapoor Kacheri), *Rheum emodi* (Dolu), *Asparagus racemosus* (Satabari), etc. are the major herbal varieties are available in abundance of mountain peaks and forest in the district

Fauna

Major attraction of this region is the abundance of wildlife and bird species that can be seen enhancing the ambience of the district. Very famous Mandakini Valley is situated in Rudraprayag district, which spreads in about 967 km. In the district is a natural sanctuary for leopard (*Panthera pardus*), Langur (*Semnopithecus entellus*), Monkey (*Macaca* spp.), kakar (*Muntiacus muntjak*), goral (*Naemorhedus goral*) etc., whereas the high altitude zones abound Himalayan black bear (*Euarctos americanus*), kakar (*Muntiacus*), Ghoral (*Nemorhaedus goral*), etc. The prominent bird species found in this region are Grey Francolin (*Francolinus pondicerianus*), Black Drongo (*Dicrurus macrocercus*), and Spotted Dove (*Streptopelia chinensis*) etc

Culture and Tradition

Diverse festivals and fairs are celebrated as an integral part of its culture in the district, in which people belonging to different faiths participate with equal vigour. The major festivals observed here include Ramnavami, Nagpanchami, Raksha Bandhan, Janmasthami, Dussehra, Diwali, Makar Sankranti, Shivaratri and Holi. Some of the traditional folk dances and songs includes Pandva Dance and Bhajans. Rudraprayag district is filled with divine aura of ancient temple include Kedarnath Temple, Kartikswami temple, Kalimath, Triyuginarayan, Indrasani Mansa Devi Temple, Madmaheshwar Temple, Tungnath Temple, Omkareshwar Temple and many more.

ENVIRONMENT CONCERNS IN THE DISTRICT

The district is vulnerable to natural calamities not only due to its Seismicity but due to regular occurrence of hazards such as Landslide, cloudburst, flash flood etc. The district witnesses a number of landslides which are triggered due to Geo-tectonic instability which is enhanced particularly during monsoon period. The reason for this is the increased pore water pressure and downslope acting forces. They act together along with reduced frictional force to provide favourable conditions for downslope mass movement.

Mandakini valley have a number of pilgrim and tourist destinations that include Kedarnath, Trijuginarayan, Okhimath, Kalimath, Madhyamaheshwar, Makkumath, Tunganath and Chopata. Hence the area is visited by large number of people every year, particularly during the pilgrimage season that coincides with the monsoon period, rainy season in the Indian subcontinent. The region is therefore economically dependent on the tourism and pilgrimage. But the disruption of the tourist or pilgrim traffic due to landslides has major adverse impact on the economy. Landslides are therefore a major cause of concern not only for the government but also for the people.

Along with landslides, localised heavy precipitation often results in flash floods in the area. In the past the district has witnessed many environmental hazards. It has been devastated over and again by landslides and flash floods. More recent disaster was observed in 2013 known as Kedarnath Disaster due to Outburst of chorabari lake and cloudburst within the same timeframe. In 2013 monsoon arrived early and it caused massive devastation in the district, particularly in the Mandakini valley. More than 4,000 persons went missing in this disaster that caused massive loss of infrastructure and property. Repeated devastation and losses due to natural hazards suggests that the area is inherently vulnerable and fragile.

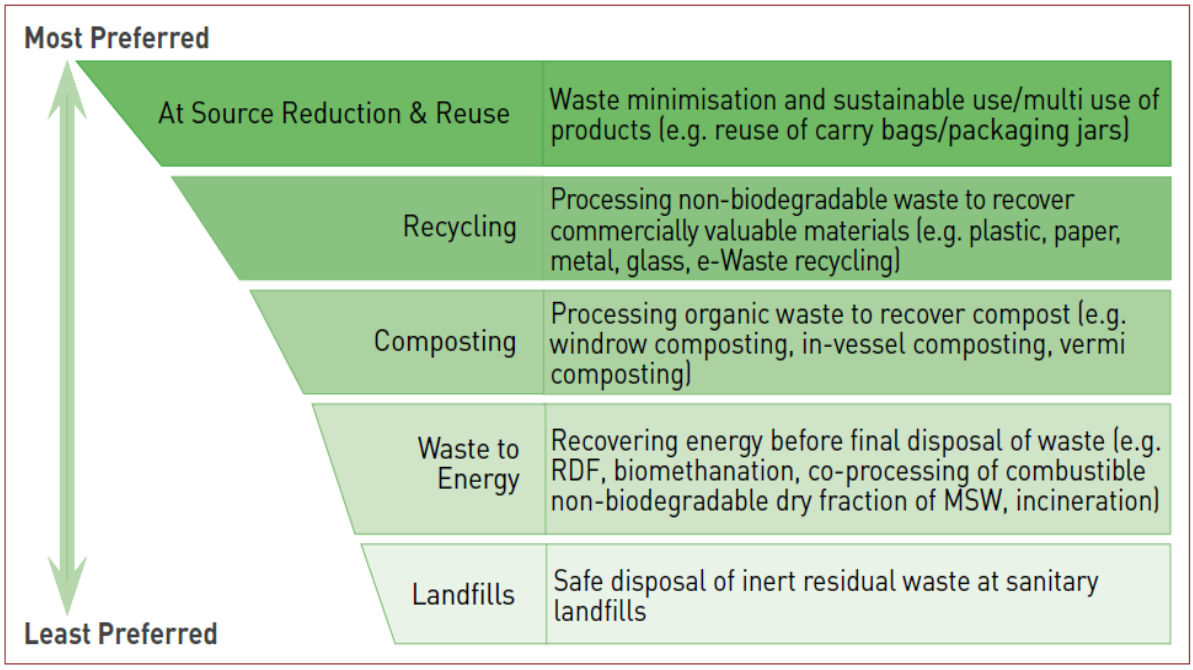
DATA AND IMPACT ANALYSIS

SOLID WASTE MANAGEMENT

Ministry of Environment, Forest and Climate Change (MoEF&CC) defines Municipal Solid Waste (MSW) as commercial and residential waste generated from a municipal area in either solid or semi-solid form excluding hazardous waste (Industrial), but including treated bio-medical waste. Predominantly, about 0.17 kg of MSW is generated per capita per day in small towns compared to about 0.67 kg per capita per day in cities. More than 70% of waste in India is considered to be dumped in an unsatisfactory manner (Sharma and Jain, 2019).

Integrated Solid Waste Management (ISWM)

It is based on the waste management hierarchy, with an aim to reduce the amount of waste being disposed while maximizing resource recovery and efficiency. Based on this waste management hierarchy, an assessment of local needs and conditions should lead to the selection of an appropriate mix of process and technologies.



Source: MoUHA, 2016

Fig. 2 New Waste Management Paradigm

Solid Waste Management in Rudraprayag District

Rudraprayag district is not very densely populated, hence the waste generation is less compared to other districts of the state (Table 7). Almost all ULBs are performing basic waste management operations such as door to door collection, segregation at source etc. with full potential.

Table 7. Inventory of Total Solid Waste Generation

Name of Urban Local Body	**Population *(2011 census)***	**Number of Wards**	**Solid waste generation *(MTPD)***			
			Dry	**Wet**	***Other Waste**	**Total**
Nagar Palika Parishad Rudraprayag	9313	07	02	1.2	0.33	3.53
Nagar Panchayat Agastmuni	6557	07	1.25	0.6	0.163	2.013
Nagar Panchayat Kedarnath	612	01	0.2	0.3	NIL	0.5
Nagar Panchayat Tilwara	2393	04	0.05	0.84	0.23	1.12
Nagar Panchayat Ukimath	3638	04	0.75	0.50	Not quantified	1.25

(Source: District Administration Rudraprayag, 2021)

**Other waste may include sanitary waste, domestic hazardous waste, horticulture waste etc.*

Table 8. Waste Management Operations

Waste management Operations	**Outcome**	
Segregation at source	**ULB**	**Source Segregation (%)**
	NPP Rudraprayag	100
	NP Agastmuni	100
	NP Kedarnath	Partially
	NP Tilwara	100
	NP Ukimath	100
Door to Door Collection	All the ULBs in the district have 100% coverage for door-to-door collection.	
Sweeping	All the ULBs in the district are accomplishing 100% sweeping by manual method.	
Segregated waste Transport	**ULB**	**Segregated Waste Transport**
	NPP Rudraprayag	Complete
	NP Agastmuni	Complete
	NP Kedarnath	Partially
	NP Tilwara	Complete
	NP Ukimath	Complete
MRF (Material Recovery Facility) operations	NPP Rudraprayag, NP Agastmuni and NP Tilwara have operational MRF within the district.	
Involvement of (Non-Governmental Organizations (NGOs) / Private agencies	Only NPP Rudraprayag, is working with private agency (Green energy group) for segregation and wet waste management operations.	
Authorization and issuance of Identity cards to waste pickers	**ULB**	**Numbers**
	NPP Rudraprayag	55
	NP Agastmuni	30
	NP Kedarnath	26
	NP Tilwara	16
	NP Ukimath	19

Linkage With Treatment Storage and Disposal Facilities (TSDF) / Common Bio-Medical Waste Treatment Facility (CBMWTF)	NPP Rudraprayag, NP Agastmuni and NP Tilwara have linkage with NEPRA group authorized by Indian government.

Table 9. Present Infrastructure for Waste Management Operations

Name of ULB	**Inventory of infrastructure involved in waste management operation**					
	Waste collection trolleys	**Mini collection trucks/ tractors/ others**	**Composting units/ On site composting facilities**	**Material Recovery Facility (Available /Not Available)**	**Landfills (Open Dumping/ Trenching Ground/sanitary landfills)**	**Remarks**
NPP Rudraprayag	25	03	06	Available	Trenching Ground	Decentralized composting facility is available in 06 locations. There are no composting machines are installed at MRF.
NP Agastmuni	25	04	06	Available	Trenching Ground	• 06 composting pit available within the ULB. • Trenching ground (9000 m^2) is under process.
NP Kedarnath	Not available	Not available	10	Not available	No	• 10 Single time used composting pit available within the ULB but they are not using the compost generated from the pits.
NP Tilwara	02	03	04	Available	Trenching Ground	• Shortage of collection trolleys.
NP Ukimath	12	1	Household pits	Not Available	Trenching Ground (In progress)	• DPR is approved for establishment of Trenching Ground.

Table 10. Methods of Treatment, Disposal and Recovery

Name of ULB	**Wet waste management** ***(Centralised or on-site composting)***	**Dry Waste Management** ***(waste to Energy/Recycling/incineration/ open Dumping in Trenching ground/ sanitary landfill)***	**Remediation of old dump site**
NPP Rudraprayag	There are 06 decentralized composting pits available for disposal of wet waste.	• Dry waste is segregated into 20 different categories by Green Energy Group at established MRF (ward no. 07). • Non-recyclable Dry waste after segregation is sold to Cement factory at Rajasthan and rest is sent to waste to energy plant in Gajipur (by NEPRA Group). • KK Traders manage recyclable dry waste. • NPP Rudraprayag has earned almost 5 lakh rupees since 2019 by selling the recyclable. Year / Income (Lakh): 2019 – 0.90; 2020 – 0.87; Aug, 2021 – 3.50	Not Initiated
NP Agastmuni	There are 06 operational composting pits for wet waste management.	• Dry waste is segregated into 14 categories at established MRF. • One compactor machine is also available for managing the dry waste. • Non-recyclable Dry waste after segregation is sold to Cement factory at Rajasthan and rest is sent to waste to energy plant in Gajipur *(by NEPRA Group*). • NP Agastmuni is earning 1.5 lakh rupees every year by selling waste and collection charges by every household	Not Initiated
NP Kedarnath	10 single time used composting pits are available for wet waste management in the ULB.	Plastic waste is segregated from solid waste. After segregation plastic waste is sending to Sonprayag.	Not initiated
NP Tilwara	There are 04 composting pits operational for wet waste management.	• Dry waste is segregated into 09 categories at established MRF. • With some extent non-biodegradable dry waste is sold to local 'kabadi'. • NP Tilwara acquired approx. 02 lakhs rupees since 2020 to August, 2021 by selling waste and household & commercial charged for waste collection. • After segregation the non-recyclable dry waste is sold to Cement Factory at Rajasthan and for using as energy, waste is sent to Gajipur by NEPRA Group and recyclable dry waste is managed by KK Traders.	Not initiated
NP Ukimath	• Household based composting pits are available for bio degradable waste management within the ULBs. • DPR is approved for trenching ground for better use of wet (bio-degradable) waste.	• Dry waste is segregated manually into 07 categories at ward No. 04 (Bhatteswar) • NP Ukimath acquiring approx. 01 lakhs 30 thousand rupees every by selling waste and household & commercial charged for waste collection. • With some extent non-biodegradable dry waste is transported to Agastmuni MRF. • Leftover dry waste is sold to local 'kabadi' by ULBs.	Not Initiated

Table 11. Gap Identification

Name of ULB	Observed Shortcomings	Remarks
NPP Rudraprayag	Lack of machinery at MRF	There is no composting machine available at MRF.
	Lack of Remediation of old dumping sites (legacy waste).	At present, no initiation has been taken to improve/repair to the old dump sites.
	Lack of laboratory facility	No machine is available to check the quality of bio-compost.
NP Agastmuni	Lack of dumping area of waste	An area about 9000 m^2 trenching ground is under process.
	Less involvement of Private agencies for waste management operations.	Nagar Palika claims that they are self-sufficient to manage the daily based municipal solid waste.
	Lack of management for reusable waste material	No initiation has been taken to managing the reusable waste.
	Lack of laboratory facility	No machine is available to check the quality of bio-compost.
NP Kedarnath	Lack of source segregation of waste	Partially source segregation is performed
	Partial segregated waste transport	After collection of partially segregated waste, plastic waste is transported to Sonprayag. However Biodegradable waste is dump into the single time used pits.
	Lack of any Material Recovery Facility.	Lack of MRF has made waste segregation less important in the ULB.
	Non availability of dumping site	A DPR has been approved for trenching ground to improve the waste management operations in the ULB.
	Lack of Infrastructures	Presently, there are no waste collection trolleys/tractors/others collection Machines are available in the town. Due to harsh topographic condition in this area most of the waste collection is performed by manually (by Sanitation worker).
	Lack of Linkage with TSDF	No linkage found with any treatment, storage and disposal facility.
NP Tilwara	Lack of Infrastructure	At present there are very few amounts of waste collection and transporting facility available in the ULB.
	Lack of laboratory facility	No machine is available to check the quality of bio-compost.
	Lack of management for reusable waste material	No initiation has been taken to managing the reusable waste.
	Lack of selling the bio composting	No initiation has been made for selling the bio compost by this ULB
NP Ukimath	Lack of any Material Recovery Facility.	Lack of MRF has made waste segregation less important in the ULB, although this ULB is transporting their waste to Agastmuni MRF facility with some extent.
	Lack of composing facilities	No composting pits are available in the ULB for wet waste management although household based small pits are available for composting of biodegradable waste.
	Non availability of dumping site	A DPR has been approved for trenching ground to improve the waste management operations in the ULB.
	Lack of Linkage with TSDF	No linkage found with any treatment, storage and disposal facility.

Table 12. Proposed Policies and Budget Requirement put forward by Different Stakeholders in the District

Name of ULB	Stakeholders Responsible	Proposed Policy	Current status and Budget requirement
NPP Rudraprayag	Nagar Palika Parishad	Establishment of SWM infrastructure and Revamping waste segregation and disposal of solid waste.	• An amount of 50 lakh rupees is using to manage the solid waste throughout the year. • An amount of 133.63 lakhs rupees DPR has been approved for the improvement of solid waste management within the ULB. • There are 55 Prayavaran Mitra working for management of solid waste. • There is one cleaning Inspector is needed for monitoring the SWM within the ULB.
		Third party involvement in Waste Management operations	• Currently KK Traders, Green Energy and NEPRA Group are involved in SWM as third-party organization.
NP Agastmuni	Nagar Panchayet	Establishment of SWM infrastructure and Improvement of Solid waste management techniques.	• 100 % door to door collection and Source segregation of biodegradable and non-biodegradable waste is managing by Prayavaran Mitra at household level. • There are 30 sanitation workers working for SWM. • An amount of 05 lakhs rupees is using to manage the solid waste throughout the year. • An amount of 97.53 lakhs rupees DPR has been approved for the improvement of solid waste management within the ULB.
		Third party involvement in Waste Management operations	• Currently NEPRA Group are involved in SWM as third-party organization.
NP Kedarnath	Nagar Palika	Improvisation of solid waste management	• DPR has been approved for establishment of trenching ground. • 26 Prayavaran Mitra working for management of solid waste in the ULB.
NP Tilwara	Nagar Panchayet	• Improvization of SWM and Revamping waste segregation and disposal of solid waste.	• 100 % door to door collection and segregation of biodegradable and non-biodegradable waste is managing by Prayavaran Mitra at household level. • There are 16 Prayavaran Mitra working for SWM. • A DPR has been approved for the Dumping sites (area - 0.960 ha) to improvement of solid waste management within the ULBs. • An amount of 35 lakhs rupees budget has required for SWM of Tilwara ULB.
		• Third party involvement in Waste Management operations	• Currently KK Traders and NEPRA Group are involved in SWM as third-party organization.
NP Ukimath	Nagar Panchayet	Management of solid waste.	• Collection and segregation of solid waste is managing by Prayavaran Mitra at household level. • There are 19 Prayavaran Mitra working for SWM. • A DPR has been approved for Trenching Ground for better management of solid waste.

Projected Population and Waste Generation in Rudraprayag District

Forecasting waste quantities in the future is as difficult as it is in predicting changes of waste composition. Storage methods, salvaging activities, exposure to the weather, handling methods and decomposition, all have their effects on changes in waste density. As a general rule, the lower the level of economic development, the greater the change between generation and disposal.

Census population data for the year 2001 and 2011 has been taken for population forecast. Decadal population and subsequent waste forecast *(For the year 2031 and 2041)* has been done based on following presumptions:

- Arithmetic increase method has been used for the decadal population forecast, hence the rate of change of population with time is assumed to be constant.
- 1.5% yearly growth in per capita waste generation has been taken keeping in mind the changing waste paradigm and floating population *(MOF, 2009).*
- Analysis includes population and waste generation estimations only for Urban Local Bodies (ULBs) and does not include peri-urban and rural areas.

Table 13. Estimated Population and Waste Generation

ULB	**Projected Population**			**Present/Projected Waste Generation (MTPD)**		
	2021	**2031**	**2041**	**2021**	**2031**	**2041**
NPP Rudraprayag	16376	23439	30502	3.53	5.81	8.55
NP Agastmuni	7802	9047	10292	2.01	2.68	3.45
NP Kedarnath	742	872	1002	0.50	0.68	0.88
NP Tilwara	2828	3263	3698	1.12	1.49	1.90
NP Ukhimath	4149	4660	5171	1.25	1.61	2.03
Total	**31897**	**41281**	**50665**	**8.41**	**12.27**	**16.81**

Table 14. Decadal Change in Waste Generation

Name of ULB	**Rate of growth (2021-2031) in %**	**Rate of growth (2031-2041) in %**
NPP Rudraprayag	6.46	4.71
NP Agastmuni	3.34	2.86
NP Kedarnath	3.51	2.99
NP Tilwara	3.27	2.81
NP Ukhimath	2.92	2.54

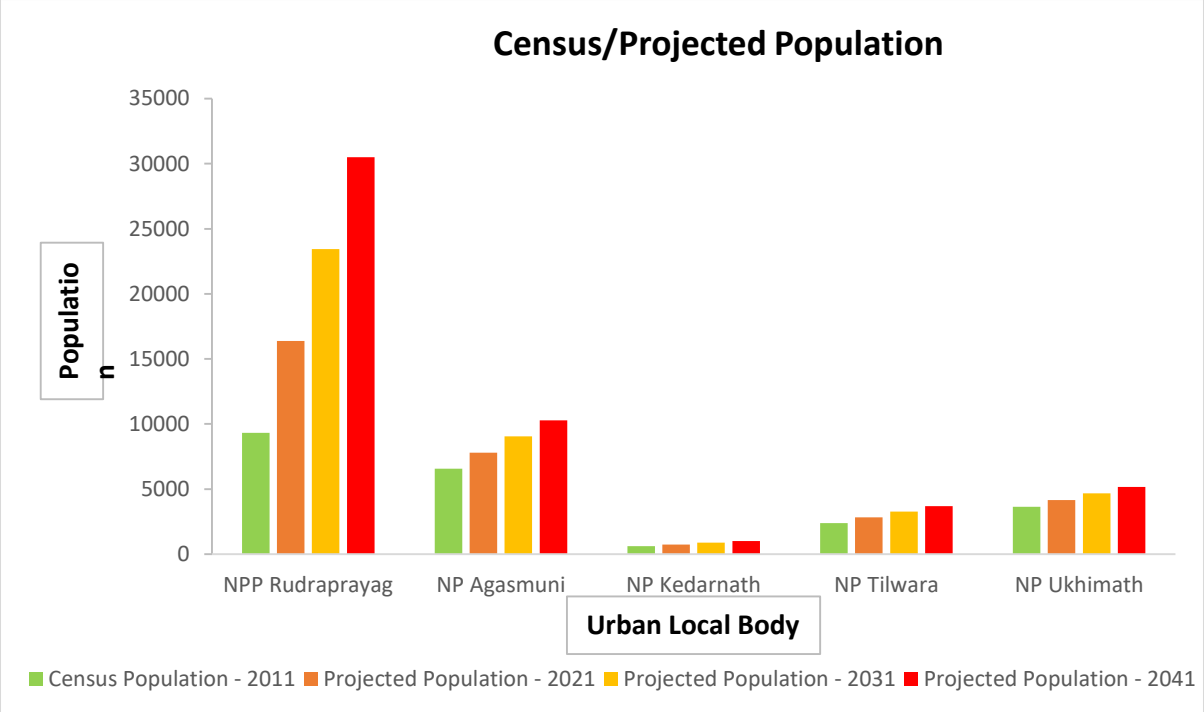


Fig. 3 Graphical representation of projected population

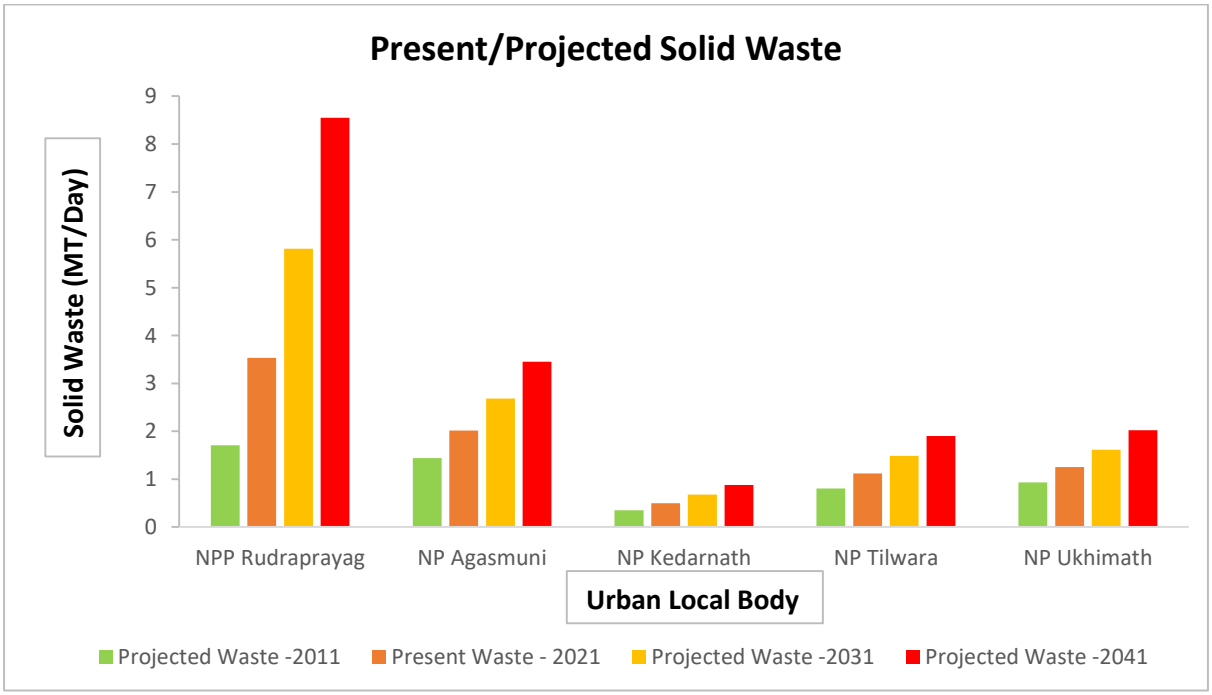


Fig. 4 Projected solid waste generation

Inferences from the Forecasted Data

- The amount of solid waste generated will increase by 4-6% in the next two decades.
- Solid waste generation in the district is expected to increase by almost 04-09 MTPD in the coming decade.

- With increasing urbanization, the physical characteristics of waste will also change. The quantity of wet waste may decrease however there would be increase in E-waste, Hazardous waste generation, plastic waste, etc.

Rural Solid Waste Management

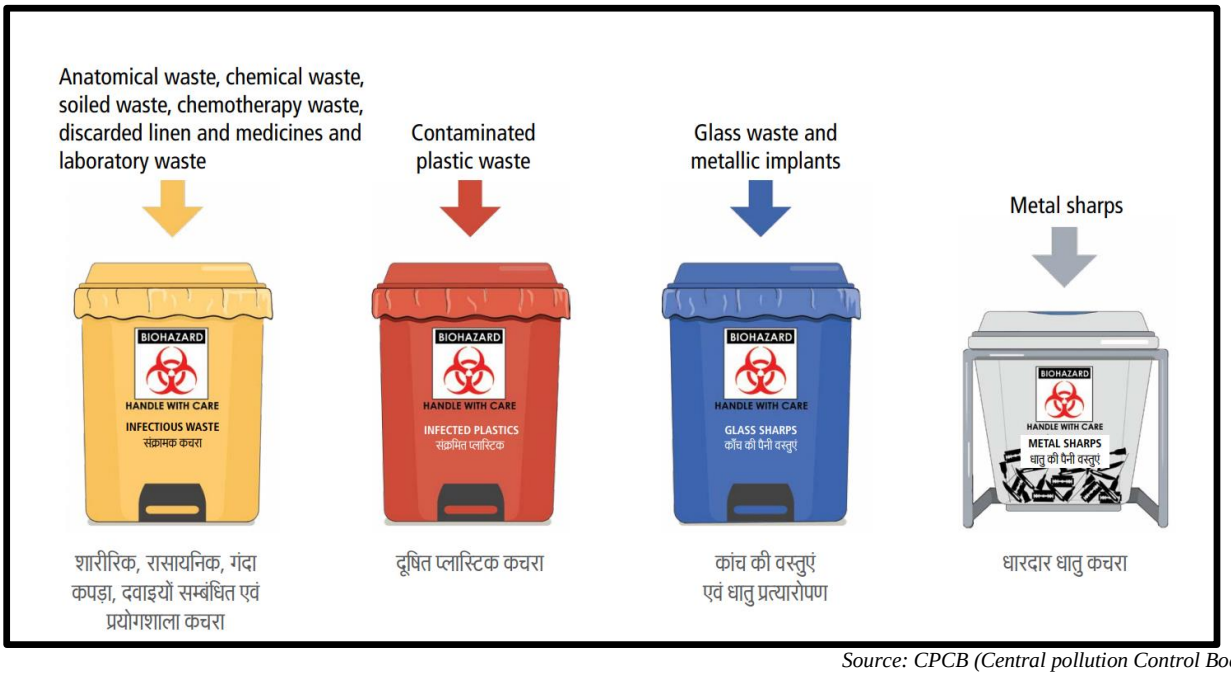
The domestic waste generated in rural households of India is increasingly becoming an issue of serious concern. As per reported by MDWS *(Ministry of Drinking Water and Sanitation)* about 0.3 to 0.4 million metric tonnes of solid waste is generated in rural India every day. With the objective of achieving ODF plus status and to improve cleanliness, hygiene and the general quality of life in rural areas, the aspect of Solid and Liquid Waste Management (SLWM) assumes greater significance. Most of the solid waste generated in rural areas can be reused after generation, because of that generation rate of rural areas is much less as compared to urban areas.

Current standpoint about Rural Waste Management in India

- According to 2011 census, 68.84% of total population in India lives in rural areas which generate almost 0.3-0.4 million metric tonnes of waste per day.
- Due to lack of commercial development, rural solid waste only contains Domestic waste (92.4%) as a major contributor to the total waste generated.
- Rural community produces comparatively more bio-degradable waste (63.5%) compared to non-bio-degradable waste (36%).
- About 78% of the rural population use open dumping as storage and collection of solid

BIO MEDICAL WASTE MANAGEMENT

According to latest biomedical waste management rules (published in 2016 and amended in 2019), biomedical waste is defined as such waste that is generated during diagnosis, treatment or immunization of human beings or animals, or in research activities pertaining thereto or in the production or testing of biological experiments. The fact sheet of WHO states that 20% of the total waste generated by health care activities is hazardous. All the biomedical waste generated is essential to be properly collected, segregated, stored, transported, treated and disposed of in a safe manner to prevent spreading infectious diseases. The health system of Uttarakhand constitutes a large network of health care facilities based on three-tier system that comprises of district level health care facilities (District hospitals, base hospitals, etc.), community health care centres (CHCs), and primary health care centres (PHCs). Biomedical waste generation has shown a wide variation in Uttarkhand due to its typical physiographical conditions and changing density of population. Handling and disposal of biomedical waste is done as per BMW rules, 2016 (Fig.3).



Source: CPCB (Central pollution Control Board)

Fig. 5 Segregation of Biomedical Waste as per BMW rules, 2016

Importance of Biomedical Waste Management in The Wake of Pandemic

As the whole world is facing the dearth of pandemic, this has led to increase in the generation of biomedical waste manifolds. Similar trend is also observed in our country as from 2019 to 2021, the daily biomedical waste generation increased from 619 MTPD to 800 MTPD *(CPCB, 2021)* in the country and from 3.8 MTPD to 6.26 MTPD *(ENVIS, 2020)* in the state. In the district itself the daily biomedical waste generation increased by four times during the peak of the pandemic. In the present times, the biomedical waste is generating not only from the health care facilities but also from the quarantine centres, residential areas where patients are in home isolation. Bio-medical waste is ought to be segregated from the municipal solid waste generated in the households during this time and thus has to be properly disposed to set aside the risk of infection to the workers handling the municipal waste.

Table 15. Inventory of current healthcare infrastructure for Bio-medical waste Management

S. No.	Parameter	Outcome	
1.	Health-care facilities in the district	***Facility***	***Numbers***
		Bedded HCFs	106
		Bedded HCFs	59
		Total	165
2.	Miscellaneous Health care Facilities in the District	***Facility***	***Numbers***
		Clinics	23
		Veterinary Hospitals	16
		Pathology Labs	02
		Dental Clinics	01
		Blood Banks	-
		Bio-research labs	-
		Total	**42**
3.	Number of health care facility authorised by SPCB/PCC	31	
4.	No. of captive disposal facilities	84 (Deep Burial)	
5.	Number of HCFs linked with Common Bio-medical Waste Treatment Facility (CBMWTF).	At present only 02 HCFs (District Hospital, Rudraprayag and Community Health Care, Agastmuni) in the district have linkage with CBMWTF. Some of hospitals have partial linkage with CBMWTF (M/S MPCC Pvt. Ltd.) but most of the cases hospitals are using captive facilities (Deep burial) available there.	
6.	Capacity of (CBMWTF) Common Bio-medical Waste Treatment Facility	100 kg/hr (incinerator) 500 litre/hr (Autoclave) 50.63 kg/day (Deep Burial)	

Disposal of Bio-Medical Waste in the District

- Most of the hospitals is preferring deep burial method for disposal of bio-medical waste. For that purpose, 84 hospitals have dedicated deep burial pits. Few hospitals have linkage with CBMWTF.
- On an average, almost 10.5 kg of waste is sent to CBMWTF (Common Bio-medical Waste Treatment Facility) in M/S MPCC Pvt. Ltd., Roorkee. An exponential increase in biomedical waste generation has posed during the Covid outbreak.

Table 16. Current status of biomedical waste management

S. No.	Action areas	Outcomes
1.	Authorisation of health care facilities by SPCB	At present, 31 HCFs are authorised in the district by State Pollution control board.
2.	Adequacy of facilities to treat biomedical waste	Presently, there is no facility is available solely for the treatment of biomedical waste in the district. As most of the cases hospitals are using captive facilities (Deep burial) available there.
3.	Segregation of BMW as per guidelines of BMW rules, 2016	There is no proper segregation in full compliance to BMW rules within the district but partly pre-segregation is taking place at Ukhimath and Agastmuni.
4.	Tracking of biomedical waste (Implementation of bar code system for tracking)	Bar code tracking facility is partly available in the district.
5.	District level monitoring committee	Established under the chairmanship of District Magistrate.

CONSTRUCTION & DEMOLITION WASTE MANAGEMENT

Construction and Demolition waste is produces in the construction, remodelling, repair and demolition of residential/commercial buildings and other structures and pavements. It is basic thumb rule that 40% of the total C&D waste originates from renovation work, 50% from the demolition work and 10% from new construction work. C&D waste mainly consists of Concrete, Soil, Sand, Bricks, Timber, Bitumen, Sanitary ware, Glass, Metals, Plastic etc. (CPCB, 2017).

Implementation of 3r Principle in C&D Waste Management

The concept of 3R which refers to reduce, reuse, and recycle particularly in the context of production and consumption is well known today. It is something like using recyclable materials more than actual practice, reusing of raw materials if possible and reducing use of resources and energy. These can be applied to the entire life cycles of products and services – starting from design and extraction of raw materials to transport, manufacture, use, dismantling and disposal. The quantity of waste generated in the construction industry is quite large and much of this waste can be predicted and avoided. Hence it is evident that application of 3R principle will help reduce the C&D waste in the construction industry.

Present state of affairs

- The volume of construction waste generated worldwide every year will nearly double to 2.2 billion tons by 2025, according to a report by Transparency Market Research.
- The country generates 150 million tonne/year C&D waste but the official recycling capacity is a meagre 6500 tonne/day or just about 1% *(as per building material promotion council).*

Table 17. Thumb rule for estimation of C&D waste generation for India

Range	Type of construction
40-60 kg/m^2	New construction
40-50 kg/m^2	Building repair
300-500 kg/m^2	Demolition of building

Resent Infrastructure Within the State

- Currently, no treatment facility is available in the state for processing the C&D waste.
- In hilly districts, ample dumping zones are not established due to which waste is dumped at the river banks.
- As the management of C&D waste is not done in the state, so it is not possible to assess the total amount of waste generated.

Table 18. Current status related to C&D waste generation in the district

S. No.	Action Areas	Outcomes/Remarks
1.	Quantity of C&D waste generated *(KGPD)*	Only Tilwara ULB estimated there is 80 kg C&D waste generated per day but other ULBs not estimated as no collection initiated. However, the quantity is assumed to be minimal.
2.	Collection of C&D waste	None of the ULBs have initiated the collection of C&D waste in the district except Tilwara.
3.	Establishment of Deposition points/Dumping Zones	A DPR is approved for Dumping zone for Tilwara and other ULBs are using Char Dham dumping zone and dumping zone made by NH.
4.	Establishment of Linkage with any C&D waste recycling facility	There is no C&D waste treatment facility in the district. Moreover, none of the ULBs have linkage with any common C&D waste treatment facility.

Table 19. Gap identification

S. No.	Observed shortcoming	Outcome/Remarks
1.	Quantification of C&D waste.	Quantification of C&D waste generated in the district is not possible, as the collection of C&D waste is not initiated in the district.
2.	Establishment of collection centre /Deposition points/Dumping Zones.	Most of the ULBs are using the NH dumping zone made for 'Char Dham' road construction for C&D waste but some ULBs are dumping openly, as the quantity of C&D waste is assumed to be minimal. So, whatever waste generated is used to filling in the base area of the buildings and if quantity of C&D waste excesses the amount then it used to fill the low-lying areas.
3.	Lack of initiative to promote recycling C&D waste.	There are no recycling or treatment facilities centre are available within the district.
4.	Lack of wider use or recycled C&D waste materials	Lack of popularization of the products made from C&D waste and low confidence is found between the people for recycled or remade product from C&D waste.
5.	Impact of C&D waste on Environment.	Lack of awareness to abatement of adverse environmental impacts by C&D waste

6.	Lack of strategies for C&D waste management.	Due to a lack of proper management and open dumping of C&D waste in unsuitable place is hampering the river as well as the surrounding environment.
7.	Implementation of by-laws for C&D waste management.	Due to lack of awareness regarding C&D waste management, it is not properly collected or segregated, and as of now the process of implementing by-laws for the C&D waste management is partially initiated by some of the ULBs within the district.

C&D Waste Management in Rural Areas

In the rural areas of the district, construction work is very limited therefore minimal amount of C&D waste is generated which mainly consists of the soil excavated from the foundation trenches and stones from the hill slopes. This excavated soil is reused in filling the plinth and trenches or many times used in filling the low-lying area. Stones obtained from the hill slopes are used in masonry work. There is an issue of improper dumping of muck on the river banks during the construction of roads which needs to be addressed.

HAZARDOUS WASTE MANAGEMENT

Hazardous Waste is any waste which by reason of characteristics such as physical, chemical, biological, reactive, toxic, flammable, explosive or corrosive, causes danger or is likely to cause danger to health or environment whether alone or in contact with other wastes or substances. Tabulation of Hazardous waste generating units and quantification of wastes generated in India is done by the respective State Pollution control boards (SPCBs). Hazardous industrial wastes in India can be categorized broadly into two categories:

- Hazardous wastes generated from various industries in India.
- Hazardous industrial wastes transported to India from western Countries for re-processing and recycling.

Present state of affairs

- The collection, transfer, processing, treatment and disposal of hazardous waste is governed by Hazardous and Other wastes (Management and Transboundary Movement) rules, 2016.
- According to CPCB Report 2019-20. In India, there are 69,308 hazardous waste generating units having authorized annual capacity to generate about 39.46 Million Metric Tonne (MMT) of hazardous waste. However, during 2019-20, about 8.78 MMT hazardous waste has been generated as per the annual returns submitted by such units.

Table 20. Hazardous Waste generation in India (2019-20)

Type of hazardous waste	Quantity/Year (MMT)	% of total waste
Land-fillable	2.13	24.29
Incinerable	0.40	4.52
Recyclable	2.07	23.59
Utilizable	4.18	47.60

Table 21. Inventory of hazardous waste in the district

S. No.	Parameter	Present status			
1.	Quantity of Hazardous waste generated in the district (in MT/Annum)	Incinerable	Landfill able	Recyclable/ Reusable	Total
		Not Estimated	Not Estimated	0.89	0.89
2.	Number of Hazardous wastes generating industries authorized by SPCB/PCC in the district	**12**			
3.	No. of display boards available in the Hazardous waste generation place	**04**			

Table 22. Current status related to hazardous waste management

S. No.	Action Areas	Outcome And Remarks
1.	No. of captive / common TSDF (Treatment storage and disposal facilities) in the district.	Currently, there is no captive or common treatment storage and disposal facility (TSDF) in the district for the treatment of hazardous waste. The hazardous waste generating in the district is send to TSDFs available outside the district.
2.	Linkage with common TSDF	01 (M/s Bhaat Oil waste Management) at Roorkee, Haridwar.
3.	Number of ULBs linked with common TSDFs	No ULB in the district is linked with common TSDFs.
4.	Contaminated sites/probable contaminated sites within the district	As per state pollution control board there are no contaminated sites within the district.
5.	Regulation of industries & facilities generating Hazardous waste	Industries generating hazardous waste are strictly regulated by state pollution control board.

ELECTRONIC WASTE MANAGEMENT

The Discarded and end-of-life electronics products ranging from computers, equipment used in Information and Communication technology (ICT), home appliances, audio and video products and all of their peripherals are known as Electronic Waste (E-waste). The ill effects of e-waste could be on soil through leaching of hazardous contents from landfills; in water due to recycling process *(if not carried our properly),* through inhalation of gases during recycling, contact of the skin of the workers with hazardous substances and contact during acid treatment used in recovery process.

Government of India has notified E-Waste Management Rules 2016, which are expanded to manufacturer, dealer, re-furbisher and Producer Responsibility Organization (PRO) of components, consumables, spares and parts of Electronics and Electrical Equipment (EEE) in addition to equipment as listed in Schedule I appended with the rules. Moreover, Compact Fluorescent Lamps (CFL) and other mercury containing lamps are also brought under the provisions of these Rules**.**

Table 23. Bifurcation of E-waste based on electronic appliances

Types of Waste	**Percentage Contribution**
Computer devices	70%
Telecom sector	12%
Medical equipment	7%
Electric equipment	8%
Others	3%

Worldwide Scenario

- Electronics and Electrical Equipment (EEE) are manufactured and disposed worldwide. In 2016, 44.7 MMT of e-waste was generated worldwide *(equivalent to 6.1kg/inhabitant)*. Following the current growth rate of rising e-waste, it is estimated that by 2021, quantity has already risen to 52.2 MMT or 6.8 kg/inhabitant.
- Out of the total e-waste produced in 2016, only 20% *(8.9 MT)* is documented to be collected properly and recycled, while there is no record of the remaining e-waste. The quantity of e-waste generated worldwide is expected to grow at a rate of 3.15% (CAGR).

Indian Scenario

- In 2016, India generated 02 MMT of E-waste. The transported e-waste in India from developed countries has further complicated the management of e-waste.
- India discarded approximately 1.85 million tonnes of e-waste in 2016 which is about 12% of the global e-waste production.

- India has emerged as fifth largest electronic waste producer in world. City-wise, Mumbai tops the list in producing electronic waste, followed by New Delhi, Bangalore and Chennai.
- The government offices, public and private sector companies generate nearly 75% of e-waste; with the contribution of individual household only being 16%.

Table 24. Current standpoints regarding e-waste generation and collection

S. No.	**Parameter**	**Outcome & Remarks**	
1.	Quantity of E-waste generated per annum (As per State pollution control board)	Uttarakhand	16260 MT/year
		Rudraprayag	126.55 kg/day
2.	Toll-free number in the district for the citizens to deposit E-waste.	Facility of toll-free number to deposit E-waste is not initiated in the district.	
3.	Collection centre established by ULBs in the district.	At present there are no specific e-waste collection centre available in the ULBs or the district administration but most of the cases each ULBs established informal e-waste collection centre at MRF to store e-waste.	
4.	Number of authorized E-waste Recyclers/dismantlers in the state.	(05) • Attero Recycling Pvt. Ltd. Raipur, Bhagwanpur • Bharat Oil & Waste Management, Mukhimpur, Laksar • Resource E-Waste Solution Pvt. Ltd. Bahadrabad • Scarto Metal Recycle Plant, Mewar Khurd, Roorkee • Anmol Paryavaran Sarakshan Samiti, Daulatpur Budhwa Shahid, Banjarewala	
5.	Linkage with any E-waste recycling facility	No ULBs in the district have established linkage with authorised E-waste recycling facility. However, the district administration has linkage with the authorised E-waste recycling facility to deposit E-waste generated from the government office. The amount of e-waste generation is very low within the district so most of ULBs are selling their e-waste to local kabaddi.	
6.	Control over illegal trading or processing of E-waste in the district.	No action taken to control over illegal trading or processing of e-waste as the e-waste generation amount is very low	

Table 25. Gap identification

S. No.	Observed Shortcomings	Remarks
1.	Improper management of E-waste	• Most of the cases collection and segregation of E-waste is not organizing properly as the quantity of E-waste generated is very minimal in the district.
2.	Establishment of Specific collection centres & toll-free number	• Ample amount of E-waste is lying idle in the government offices of the district which cannot be sent for recycling as there is no facility in the district to deposit E-waste.
3.	Lack of awareness and communication for E-waste	• Lack of awareness to proper segregation and how to dealing with E-waste. • As there are no available facilities of Toll-free number or any other communication to deposit E-waste in the district so all the E-waste generated from the residential areas is mixed with municipal solid waste and thus not treated properly.
4.	Linkage of ULBs with authorised recyclers/ Dismantlers	• Need to establish linkage with authorized recyclers and dismantlers to recycle, reuse or dismantling the collected e-waste.

WASTE WATER MANAGEMENT AND SEWAGE TREATMENT PLANT

Domestic sewage is the type of waste water that is produced by a community of people and is characterized by volume of flow, physical condition, chemical and toxic constitute and its bacteriologic status. Around 80% of water supply flows back into the ecosystem as wastewater, this can be a critical environmental and health hazard if not treated properly.

Currently, India has the capacity to treat approximately 37% of its wastewater, or 22,963 million litres per day (MLD), against a daily sewage generation of approximately 61,754 MLD according to the 2015 report of the Central Pollution Control Board. Moreover, most sewage treatment plants do not function at maximum capacity and do not conform to the standards prescribed.

Piped sewerage system connects only 31.7 per cent of the total urban households with individual household latrines. More than half of the urban population in the State relies on On-Site Sanitation (OSS) systems such as septic tanks *(53.1 per cent)* for the collection of faecal sludge and wastewater. Further, some individual households in the state discharge the waste from their toilets directly into open drains.

Table 26. Current Scenario Related to STPs in Uttarakhand

Number of STPs Installed in Uttarakhand	71
Total Sewage Generation (MLD)	627
Installed Capacity (MLD)	448.18
Operational Treatment Capacity (MLD)	345
Actual Utilization (MLD)	187 (42% of installed capacity, 54% of Operational capacity)
80 % of the state's total sewage treatment plant capacity caters to Dehradun, Rishikesh and Haridwar (Plain areas).	

(Source: ENVIS Centre on Hygiene, sanitation, sewage treatment systems and technology)

Current Scenario Related to STP in The District

At present, there are 06 storm surge water treatment plant is operational only at Rudraprayag. Other ULBs don't have any STP for sewage treatment. Rest of the district still relies on conventional method of septic tank and soak pit method for sewage disposal.

Table 27. inventory of sewage/storm surge water management (STP Rudraprayag)

Name of ULB	Population	Quantity of Sewage generated (MLD)	Strom surge water disposal	
			Treated at STP	*Untreated/partially treated*
Rudraprayag	9313	Not estimated	0.525 MLD	0

Table 28. Current standpoint regarding sewage management in the district

Name of ULB	Present state of affairs
Rudraprayag	• Rudraprayag has six storm surge water treatment facilities. There is no STP facility available for sewage water treatment at present but an initial planning is ongoing to set up a STP at Rudraprayag city by Payjal Nigam. • Uttarakhand state pollution control board and Jal Sansthan are the departments responsible for ensuing compliance to provision under status related to Sewage Treatment Plants Management.

Table 29. Proposed policies and budget requirement put forward by different stakeholders in the district

Name of ULB	Stakeholders Responsible	Proposed policy	Instruments and Budget Requirement
Rudraprayag	Pay Jal Nigam and State Pollution Control Board (SPCB)	• One STP is being planned m,to set up at Rudraprayag city for sewage water management.	Not yet estimated.

Liquid Waste Management in Rural Areas

Since the water supply for domestic purposed in rural areas has improved considerably over the years, the quantity of wastewater that is disposed as also increases. Hence effective wastewater management systems need to be introduced in the rural areas to mitigate the problem of contamination in the majority of rural areas, untreated wastewater is discharged directly into the local surroundings and water bodies. This leads to contamination of surface as well as sub-surface water, having negative effects on the environment and human health.

Current standpoint about Rural Waste Water Management in India

- With Population growth and rapid industrialization, wastewater management has become a serious issue. Rural India with old or no infrastructure has reached a tipping point.
- India has the highest number of people who don't have access to clean drinking water. Even abundance of water in certain places do not guarantee access to safe, reliable, drinking water.
- United Nations Sustainable Development goal 6 focuses on access to clean water and sanitation for all. The goal of the initiative is to sensitize communities to the advantages of hygiene and sanitation.

Table 30. Policies Undertaken for Waste Water Management in Rural India

Current Policy	Sponsoring agency	Remarks
Construction and Usage of Individual Household Latrines (IHHLs)	Under Swachh Bharat Mission-Gramin (SBM-G)	There are various models of toilets available based on safe sanitation technologies like Twin pit, Septic tank, Bio toilets etc.
Availability of Sanitation Material through Rural Sanitary marts (RSM), Self-help Groups (SHGs)	Under Swachh Bharat Mission-Gramin (SBM-G)	To provide material, services and guidance needed for constructing different types of latrines and other sanitary facilities for clean environment,
Community Sanitary Complex (CSCs)	Under Swachh Bharat Mission-Gramin (SBM-G)	Such complexes comprise of appropriated number of toilet seats, bathing cubicles etc. (Only where there is lack of space in the village for construction of household toilets.)
Financial Assistance	Under Swachh Bharat Mission-Gramin (SBM-G)	Up to Rs.12000 is provided to BPL (below poverty line) households and identified APL (Above poverty line) households for construction of one unit of IHHL. It is not the cost of the toilet but an incentive amount.
Mensural Health Management	Under Swachh Bharat Mission-Gramin (SBM-G))	It is aimed at making behavioural change in woman and adolescence girls using a clean menstrual management material to absorb or collect blood that can be changed in privacy as often as necessary for the duration of the menstruation period, and having access to facilities to dispose of used menstrual management materials.

GROUND WATER EXTRACTION/CONTAMINATION AND RE-CHARGE

Groundwater is found underground in the cracks and spaces in soil, sand and rock. Over 70% of the earth's surface is covered in water but of that water, just 1% is readily available for human use, out of which, 99% is stored beneath our feet as groundwater (The Groundwater Foundation, 2021).

Ground water extraction:

Over 80-85% of our country population depends on groundwater for drinking water. Groundwater is also one of our most important sources of water for irrigation. Due to overuse and leverage of high amount of groundwater water table decreasing with rapid rate and it will very harmful for mankind

Ground water contamination

Groundwater contamination occurs when man-made products (such as, gasoline, oil, road salts and chemicals) get into the groundwater and makes it unsafe and unfit for any kind of use for humans and as well as other animals (The Groundwater Foundation, 2021). Unfortunately, groundwater is susceptible to pollutants. Hazardous materials from the land surface can move through the soil and end up in the groundwater. For example, pesticides and fertilizers can find their way into groundwater supplies over time. Also, groundwater is contaminated by the untreated waste from septic tanks and toxic chemicals from underground storage tanks and leaky landfills.

Groundwater Recharge

Groundwater recharge is a hydrologic process, when water (rain, snow-melt etc.) moves downward from surface to groundwater. Mostly groundwater recharged by naturally but due to high amount of groundwater extraction, water table is falling down day by day. Saving groundwater is very important for mankind as it is the major sources of drinking water and agricultural irrigation water (The Groundwater Foundation, 2021). A comparison of depth to water level of August 2019 with decadal mean of august (2009-2018) indicates that there is decline of more than 4m in the groundwater level in state of Uttarakhand (CGWB,2019-20). Therefore, some artificial methods (Rainwater harvesting, Injection wells) are applied nowadays to save groundwater.

Table 31. Water Resources in the District

S. No.	Water Resource	Number	Name and Length/Area in the District			
1.	Rivers	02	**Name**	**Length (km)**	**Annual Average Discharge (m3/sec)**	
			Alaknanda	24	287.00	
			Mandakini	75	105.00	
2.	Streams	02	***Name***		***Length (km)***	
			Basuki Ganga		---	
			Madhyameshwar		---	
3.	Major Lakes / Tal / Wetland	03	***Name***	***Type***	***Elevation***	***Location***
			Deoria Tal	Permanent freshwater Marshes/ Pools	2350 m asl	30.52166 N 79.12611 E
			Basuki Tal	Tarn	4231 m asl	30.72505 N 79.03381 E
			Paiya Kund	Tarn	4910 m asl	30.73869 N 78.99936 E
4.	Springs / Gadheras	97	***Types***		***Number***	
			Springs		50	
			Gadheras		47	

Table 32. Pollution Control in Water Resources

S. No.	Parameter	Current Status
1.	Open Defecation in River/Nala/Khad	Fully Controlled
2.	Dumping of Solid waste on River Banks	Fully Controlled
3.	Control Measures for idol immersion	Idol immersion in rivers of Rudraprayag is prohibited as per the order of Hon'ble NGT.
4.	Disposal of Untreated Sewage in Rivers	Sewage is not directly discharged into water bodies (Soak pit is available at most of the household)
5.	Monitoring of Action Plans for rejuvenation of Rivers/Waterbodies	Monitored
6.	NGOs/District level campaigns on protection of water quality	District Ganga Committee of Rudraprayag is the legal body responsible for ensuring the protection of rivers and its water quality by organizing several awareness campaigns and involving different local bodies, department and NGO's.

Table 33. Information of Groundwater in District

S. No.	Parameter	Current Status
1.	Estimated numbers of Bore-wells/Tubewells	02
	Estimated numbers of handpumps	491

2.	Groundwater polluted area in the district	No data available (No groundwater survey has been done within the district).
3.	Adequacy of groundwater availability	Adequate
4.	Disposal of Untreated Sewage in Rivers	Sewage is not directly discharged into waterbodies,
5.	Access to surface water and groundwater quality in district	Water quality data is available at Irrigation Department in the district,

Current standpoint regarding Water Resources Management

Present state of affairs

Common water sources used for water supply schemes over the district are:

1. Rivulets/Naulas/Gadheras
2. Springs
3. Deep Tubewells
4. Streams
5. Khadins/Nadins/Tankas/Ponds/Wells/Oorains
6. River and Treated surface water

- An average of 54.3% of water supply schemes in Rudraprayag district is found to be dependent on Rivulets/Naulas/Gadheras, followed by Springs (36%) and Deep tube-well (6%).
- As, this district 90% of water is collected from Rivulets, Naulas, Gadheras and Springs, the several departments (Forest, Irrigation, Jal Sansthan, Gram Vikas etc.) in the district are mainly focusing on rejuvenate the Springs and Gadheras.
- Augustmuni is highest springs water dependency block in the district. An average of 39% of total water supply is directly dependent on Springs in the block (K. Kumar, et al., 2019).
- Jakholi is the highest water scarce block in the district.
- No information is currently available on the annual change of Ground water level in the district.

Policies Proposed by Stakeholders for Water Resource Management

According to Jal Shakti Abhiyan (Catch the rain) – II (Year – 2021-22), several departments like Gram Vikas/MNREGA, Agriculture/Horticulture, Jal Nigam, Forest, Payjal/Jal Sansthan, Irrigation has been aimed to store/recharge 2813.395 lakh litres water in the district and approximately these departments touched the store capacity of 1175.949 lakh litres in the district. Details of the water resources structures made by several departments for water resource management (Table 36).

Artificial Recharge of Groundwater

Water security specifically in the spring-fed river system is highly vulnerable to seasonal changes in the spring hydrology Most of the people residing in the rural and urban places in the district heavily depend on this system for drinking water and other needs. The undulating topography and diverse micro climatic conditions pose difficulty in the efficient distribution of natural water resources.

Table 34. Scope of Artificial Recharge in Rudraprayag

District	Area (km^2)	Area identified for AR (Artificial recharge) (km^2)	Volume of unsaturated zone (MCM)	Available sub-surface space for AR (MCM)	Water required for artificial recharge (MCM)	Surplus available for recharge (MCM)
Rudraprayag	1984.00	610.00	1220.00	183.00	243.00	1525.00

The major part of the district is covered by hills, valleys and numerous small and large perennial streams through which the entire runoff passes. Major part of the rainfall is lost as surface runoff. Apart from this the small rivers, nallas also act as carriers for base flow & spring water. In spite of good rainfall there is acute shortage of water especially during the summer. The state government is working for rainwater harvesting in the state under many projects to solve this issue.

Table 35. Artificial Recharge and RTRWH Structure constructed in Rudraprayag under catchment area conservation Program (CACMP)

District Name	Number of structures					Total cost (in lakhs)					Total cost (in lakhs)
	CD	CK	RTRWH	PT	CT	CD	CK	RTRWH	PT	CT	
Rudraprayag	97	41	40	23	525	9.7	1.23	14	0.46	4.9	30.29

CT-Contour Trench, CK- Chal Khal, RTRWH- Rooftop Rain Water Harvesting, CD- Check Dam, PT- Perculation Tank, NA- Data Not Available

Table 36. Artificial recharge and cost estimate in Rudraprayag

District Name	Structures proposed					Unit cost Estimate (in lakhs)					Total cost (in lakhs)					Total cost (in lakhs)
	RTRWH	CD	PT	CK	CT	RTRWH	CD	PT	CK	CT	RTRWH	CD	PT	CK	CT	
Rudraprayag	300	200	30	75	150	0.5	0.3	0.07	0.15	0.015	150	60	2.1	11.25	2.25	225.6

CT-Contour Trench, CK- Chal Khal, RTRWH- Rooftop Rain Water Harvesting, CD- Check Dam, PT- Perculation Tank, NA- Data Not Available

AIR AND NOISE POLLUTION MANAGEMENT

Air Pollution Management

The ambient air that is the atmospheric air in its natural form consists of nearly 99.9% of Nitrogen, Oxygen, Water vapors, Carbon dioxide, and some other gases like helium, argon, methane, argon, etc. surrounds the earth and forms its atmosphere. Any undesirable change in the composition of ambient air is called air pollution. The undesirable substances can be in solid, liquid, and gaseous forms and when present in sufficient concentration for a sufficient time under certain conditions can endanger human health and welfare of plants and animals. According to state of Global Air report 2020, Air pollution has now become the biggest health risk in India. Most of the cities in our country (majority of them are from the region of Indo-Gangetic plains) are facing the problem of air pollution which has led to increase in cases of breathing discomfort and other related diseases. To tackle the problem of air pollution in our cities, Government of India has taken many steps, one of them being National Clean Air Program (NCAP) 2019. Under this programme, 122 cities in the country are identified as non-attainment cities which includes three cities from the Uttarakhand *(Dehradun, Rishikesh and Kashipur)*. These are the cities that have fallen short of the National Ambient Air Quality Standards (NAAQS) for over five years. Goal of National Clean Air Program (NCAP) is to meet the prescribed annual average ambient air quality standards at all locations in the country in a stipulated timeframe. The tentative national level target of 20% to 30% reduction of PM2.5 and PM10 concentration by 2024 is proposed under the NCAP taking 2017 as the base year for the comparison of concentration.

Table 37. national ambient air quality standards in India.

Pollutant	**Time weighted average**	**Industrial, Residential, Rural and Other Areas**	**Ecologically Sensitive Area (notified by Central (Government)**
		Concentration in Ambient Air (µg/m ^{3})	
Sulphur Dioxide (SO2)	Annual* 24 hours**	50 80	20 80
Nitrogen Dioxide (NO2)	Annual* 24 hours**	40 80	30 80
Particulate Matter (size less than 10 µm) or PM10	Annual* 24 hours**	60 100	60 100
Particulate Matter (size less than 2.5 µm) or PM2.5	Annual* 24 hours**	40 60	40 60
Ozone (O3)	8 hours* 1 hour** 24 hours**	100 180 60	100 180 60

Benzene (C6H6)	Annual*	5	5
Ammonia (NH3)	Annual* 24 hours**	100 400	100 400
		Concentration in Ambient Air (mg/m^3)	
Carbon Monoxide (CO)	8 hours* 1 hour**	02 04	02 04
		Concentration in Ambient Air (ng/m^3)	
Benzo(a)Pyrene (BaP)-particulate phase only	Annual*	1	1
Arsenic (As)	Annual*	6	6
Nickel (Ni)	Annual*	20	20

Source: National Ambient Air Quality Standards, Central Pollution Control Board Notification in the Gazette of India, Extraordinary, New Delhi, 18th November, 2009.

** Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.*

*** 24 hourly or 8 hourly or 1 hourly monitored values, as applicable, shall be complied with 98% of the time, they may exceed the limits but not on two consecutive days of monitoring.*

Current Standpoint Regarding Air Pollution in the District

As the monitoring of ambient air quality is not yet started in the district so the present condition regarding the air quality is very difficult to ascertain. With the increase in number of forest fire events and increase in number of vehicles due to tourism and other developments in the district, the problem of air pollution is gradually increasing which needs to be addressed.

Table 38. Air Quality Monitoring and data Accessibility

Action Area	Outcomes
Number of automatic air quality monitoring stations in the district	Not Initiated
Number of manual air quality monitoring stations in the district	Not Initiated
Availability of air quality monitoring data	No data available

Table 39. Identification of Sources of air pollution

Action area	Outcomes
Number of non-attainment cities in the district	No city in the district is classified as non-attainment city according to national clean air program *(NCAP).*
Prominent sources of air pollution in the district	Unprecedented forest fires and vehicular pollution are major reasons for air pollution in the district.

Table 40. Control measures for industrial/non-industrial air pollution

Action Areas	Outcomes
Identification of Prominent air polluting sources	Forest fires and Vehicular pollution are identified as major pollution sources.
Control of industrial air pollution	At Rudraprayag district 08 industries are not meeting with standard air quality. Need to continuously monitored their progress.

Control of non-industrial air pollution	
(a) Control open burning of waste	Although open burning of waste is not allowed, even then practices of open burning of waste is common in the district. Inefficient waste collection system could be one of the reasons.
(b) Control of forest fires	Forest department is trying their best to control forest fires but the result is yet to be seen on ground. Every year hectares of forests are damaged due to forest fires.
(c) Control of vehicular pollution	There are 03 vehicle pollution check entre (Diesel + Petrol - 01, Diesel - 01, Petrol - 01) in the district.
District level action plan for air pollution	At present, no such action plan has been prepared.
Awareness on air Quality	There is the mind set in the district that air pollution is not an issue in the hilly region so local citizens are not aware of the problem of increasing levels of air pollutants in the district especially in the urban centres of the district.
Development of Air pollution complaint redressal system	Not Initiated

Table 41. Proposed policies and budget requirement put forward by stakeholders in the district

Proposed policies	**Responsible agencies**	**Action plan and Budget requirement**
Installation of air quality monitoring station at Rudraprayag	State Pollution Control Board	State pollution control board is planning to install air quality monitoring systems in all the district headquarters. Under this project there is a proposal of establishing an air quality monitoring station in Rudraprayag at an estimated cost of rupees 5 lakhs.
Provision of funds to Van Panchayat for control of forest fires	Forest Departments	To ensure public participation in tackling forest fires, each Van panchayat is being paid 1lakh rupees.

Table 42. Gap Identification

Serial No.	**Area of Concern**	**Remarks**
1.	Forest Fires	• Lack of staff • Multiple departments are involved to resolve the issues; hence lack of coordination and responsibility sharing has been observed. • Sloping terrain makes it difficult for fire tenders to reach high altitudinal areas. • Abrupt migration from villages and change in living habits has exaggerated the situation. • Lack of inspection in forest areas under Van panchayat and Civil Forest.
2.	Vehicular Pollution	No air pollution monitoring station in the town, hence much of the pollution goes unnoticed.

Noise Pollution Management

Regular exposure to elevated sound levels that may lead to adverse effects in humans or other living organisms. According to WHO sound levels less than 70 dB are not damaging to living organisms and exposure of noise level beyond 85 dB constantly for more than 8 hrs. may be hazardous and leads to loss of hearing. Although noise pollution is a big issue in the district but proper monitoring is required maintain noise level within the desirable limits. Following table represents the permissible noise level standards in India (Table 43).

Table 43. Permissible noise level standards

Area code	Category of area/zone	Limits in dB (A) L_{eq}^{*}	
		Day Time	Night Time
A	Industrial Zones	75	70
B	Commercial Zones	65	55
C	Residential Zones	55	45
D	Silence Zones	50	40

Source- Noise Pollution (Regulation and Control) Rules, 2000

Note: - 1. Day time shall mean from 6.00 a.m. to 10.00 p.m.
2. Night time shall mean from 10.00 p.m. to 6.00 a.m.
3. Silence zone is an area comprising not less than 100 metres around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority
4. Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.

* dB(A) L_{eq} denotes the time weighted average of the level of sound in decibels on scale 'A' which is relatable to human hearing.

A "decibel" is a unit in which noise is measured.

"A", in dB(A) L_{eq}, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear.

L_{eq}: It is an energy mean of the noise level over a specified period.

Table 44. Current status related to noise pollution management

S. No	Parameter	Current Status
1.	Number of noise level measuring devices available with various agencies in the district	At present no noise level monitoring device is installed in the district.
2.	Number of complaints received by state pollution control board related to noise pollution in last 1 year	No complaint either by SPCB or District Authority is received by state pollution control board in last 1 year.
3.	Implementation of ambient noise standards in residential and silent zones.	Local police are responsible for the implementation of the ambient noise level standards.
4.	Silent Zones in the district	At present, Hospitals, Educational institutions and Courts are declared as silent zone in the district.
5.	Setting up of Sign Boards	Sign boards around the silent zones are installed in the district.

ILLEGAL SAND MINING

Sand being an important economic resource and second most used mineral after water, is one of the main ingredients of concrete and mortar. Beside its economic importance, it also constitutes an important abiotic component in aquatic ecosystem like rivers. As our country has seen robust growth in the infrastructure sector in the recent decade the demand of sand increased by manifolds. Further with the announcement of national infrastructure pipeline project the demand of sand is going to increase exponentially in the near future. In recent years, Uttarakhand has also seen increase in the riverbed quarrying operations. With the establishment of stone crusher industry especially in the southern Terai and Bhabar region of the state, scale and intensity of RBM (Riverbed Minerals) excavation has further increased in past few decades. Uncontrolled and illegal mining of river bed minerals like sand has led to loss of revenue to the state, degradation of aquatic and riparian habitat *(through large changes in the channel morphology)* and geology of adjoining ground water system.

Guidelines to Monitor Sand Mining in India

The Mines and Minerals (Development and Regulation) Act, 1957 has empowered state governments to make rules to prevent illegal mining, transportation and storage of minerals. However, still large number of illegal mining cases are registered in the country and in some cases, many of the officers even lost their lives while executing their duties to curb illegal mining. Ministry of Environment, Forests and Climate Change (MoEFCC) put forward the sustainable sand management guidelines (SSMG) 2016, which focus on the management of the sand mining India, but there is a need to revamp the existing system for effective enforcement of regulatory provisions and their monitoring. Recently, in 2020, new set of guidelines have been put forward by Ministry of Environment, Forests and Climate Change (MoEFCC) in 2020, which focuses on the effective monitoring of sand mining (from the identification of sand mineral sources to its dispatch and end-use by consumers and general public) and uniform protocol for the whole country. Also, states are advised to conduct river audits and monitoring of mining activities with night vision drones and other modern surveillance equipment.

Table 45. Current Standpoints Regarding Mining Activities in the district

Total Area of District (km^2)	1984 km^2
Area Covered under Mining (m^2)	18070 m^2
Royalty acquired from mining areas	5681338 rupees
Type of Mining Activity	Sand mining
Sand Mining activity observed in the district	Sand mining operations are widespread in the bed of Alaknanda and Mandakini river.
Area affected by illegal sand mining in the district	290 m^2
Penalty imposed from illegal sand mining	311650 Rupees
Number of Mining Licenses given by the District Authority	06

Table 46. Compliance to Environmental Standards

Number of Mining areas meeting Environmental Clearance Conditions	06
Number of Mining areas meeting consent conditions of UKPCB	06
Number of Mining operations suspended for violations to environmental norms	Nil
Number of Pollutions related complaints against Mining operations in past one year	Nil

REJUVENATION OF WATER BODIES

Most of India's major water resources *(underground waterways, lakes, rivers and reservoirs)* have to depend on monsoon rains to replenish/recover them. Nearly 600 million Indians faced high to extreme water stress and about 2 lakh people died every year due to inadequate access to safe water. The NITI Aayog in 2018 released the results of a study warning that India is facing its "worst water crisis" in history and that demand for potable water will outstrip supply by 2030, if concrete steps are not taken. If matters are to continue, there will be a 6% loss in the country's GDP by 2050. Due the high amount of water extraction and mismanagement of water resources are causing drought and sudden flood in several part of our country. Rejuvenation of waterbodies also play a vital role to improve the water quality and storage of surface run off water. For these reasons we must need to store, manage and rejuvenate the existing waterbodies. We can use several government policies/Schemes like Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), Atal Bhujal Mission etc. to restore and rejuvenate the water bodies. The Water Stress Index 2019 by London-based Verisk Maplecroft ranks India as the 46th highest risk country *(Verisk Maplecroft 2019)*. India is also 13th on the Aqueduct's Water Risk atlas and listed as one of the world's ***"extremely water-stressed countries"*** *(World Resources Institute 2019).*

Table 47. Present scenario in the district

Total number of Water bodies	**70**			
Number of waterbodies rejuvenates	Aim	Expenditure (Lakhs)	In Progress	Expenditure (Lakhs)
	15	50 Lakhs	08	49.98750
Details of water bodies rejuvenated	***Name of the Springs***		***Detail Expenditure (In Lakh)***	
	Kudi Gadhera, N. Jakholi		05	
	Muralya Adhera, N. Jakholi		05	
	Dangchaura, Ragsi, Agastmuni		05	
	Pittal Chauncha, Kakoda Khal, Agastmuni		05	
	Akharbari, Agastmuni		10	
	Sen Gadhera, Dhanpur, Rudraprayag		9.98	
	Lauga, S. Jakholi		05	
	Launga, S. Jakholi		05	

The rivers in Rudraprayag district are mostly Glacier-fed River. The major river and streams (Mandakini, Alaknanda, Basuki Ganga and Madyameshwar Ganga) in this district are mostly perennial and doesn't require any intervention for rejuvenation.

Rudraprayag district is depended 90% on Rivulets, Naulas, Gadheras and Springs for supplying of water (K. Kumar, et al., 2019). So, the district authorities are mainly focusing on to rejuvenate the Springs/Gadheras. In the financial year 2021-22, the Forest Department were aiming to rejuvenate the 15 springs and they have been rejuvenated almost 08 waterbodies. Several departments like, Gram Vikas, Irrigation, Jal Sansthan, Agriculture/Horticulture are also working side by side on water conservation and waterbody rejuvenation (Table 48).

Table 48. Preparation of water resource management structures (year - 2021-22)

Unit of work / Name of the structures	Name of the responsible Department / Stakeholders											
	Gram Vikas / MNREGA		Agriculture / Horticulture		Jal Nigam		Forest		Payjal / Jal Sansthan		Irrigation	
Jal kund	Aim	In progress	Aim	In progress	Aim	In progress	Aim	In progress	Aim	In progress	Aim	In progress
Chal Khal	10 - (120 m^3)	07 (120 m^3)					02 (250 m^3) 13 (100 m^3) 35 (50 m^3) 51 (20 m^3) 18 (10 m^3)	02 (250 m^3) 13 - (100 m^3) 35 (50 m^3) 51 (20 m^3) 18 (10 m^3)				
Farm pond	462	190							10	02	02	02
Check dam	178	53										
Contour trench	151	52	05	05	4549	1939					02	02
Rainwater storage tank	4910	4640			4833	446	100	100				
Springs rejuvenation	52	50	10	06	19	05						
Cleaning of ponds	237	94										
Plantation area	120	02										
Kaccha Pond	45 (ha.)	38 (ha.)					470 (ha.)	470 (ha.)				
Irrigation tank			10	06								
Perculation pit			31	15	06	06						
Recharge Pit							100	100				
Water hole					2521	1860						
Individual soak pit							04	04				
House recharge pit									680	403		
Land and water conservation											26	09
No. of plant planted							62	62				
							4.7 lakhs	4.7 lakhs				

Source: *Irrigation and Forest Department, Rudraprayag*

PLASTIC WASTE MANAGEMENT

Plastic waste is defined as the accumulation of plastic objects (e.g., Plastic bottles, bags etc.) in the environment that adversely affects the Wildlife and Humans. The ongoing pandemic has caused a rapid growth in the generation of Plastic waste for the medical, packaging and other services *(like PPE kit, gloves, face shield, packaged food etc.).* Its broad range of application is in packaging films, wrapping materials, shopping and garbage bags, fluid containers, clothing, toys, household and industrial products, and building materials.

Plastic products have become an integral part in our daily life pertaining to the fact that its production has crossed 150 million tonnes per year globally *(CPCB, 2013).* India generates 15 million tonnes of plastic waste every year but only one fourth of this is recycled due to lack of a functioning solid waste management system. This leads to burden on the landfills and poor socio-economic conditions of the waste pickers, mostly women *(UNDP, 2018-2024).*

It is a fact that plastics will never degrade and remains on landscape for several years. The recycled plastics are more harmful to the environment than the virgin products due to mixing of color, additives, stabilizers, flame retardants etc.

Table 49. Inventory of Plastic Waste Generation

Name of Urban Local Body	Population (2011 census)	Number of Wards	Estimated Quantity of Plastic Waste Generated (MT/Day)
NPP Rudraprayag	9313	07	0.048
NP Agastmuni	6557	07	0.047
NP Kedarnath	612	01	0.020
NP Tilwara	2393	04	0.025
NP Ukimath	3638	04	0.018

Table 50. Plastic Waste Management Operations

Waste management Operations	Outcome		
Door to Door Collection	NPP Rudraprayag, NP Agastmuni, NP Kedarnath, NP Tilwara and NP Ukimath have 100% coverage for door to door collection.		
Segregation at source	**100% source segregation**	**Partial source segregation**	**No source segregation**
	NPP Rudraprayag	NP Kedarnath	None
	NP Agastmuni		
	NP Tilwara		
	NP Ukimath		

Sweeping	All the ULBs in the district are accomplishing 100% sweeping by manual method.	
Segregated waste Transport	**ULB**	**Segregated Waste Transport**
	NPP Rudraprayag	Complete
	NP Agastmuni	Complete
	NP Kedarnath	Complete
	NP Tilwara	Complete
	NP Ukimath	Complete
Material Recovery Facility (MRF) operation	• NPP Rudraprayag, NP Agastmuni and NP Tilwara have MRF within the district. • NP Kedarnath and NP Ukimath have no MRF facility.	
Linkage with Public Relation Officers (PROs) of producers	No ULB has established links with PRO of plastic producers.	
Involvement Of (Non-Governmental Organizations (NGOs) / Private agencies	NPP Rudraprayag, NP Agastmuni and NP Tilwara is working with private agencies for plastic waste as well as solid waste management in the district. Other ULBs don't have any linkage/relation with NGOs / Private agencies for solid waste management.	
Number of sanitation workers / Paryavaran Mitra	***ULB***	***Numbers / Status***
	NPP Rudraprayag	55
	NP Agastmuni	30
	NP Kedarnath	26
	NP Tilwara	16
	NP Ukimath	19
Authorization and issuance of Identity cards to waste pickers	***ULB***	***Numbers / Status***
	NPP Rudraprayag	Initiated (55)
	NP Agastmuni	Initiated (30)
	NP Kedarnath	Initiated (26)
	NP Tilwara	Initiated (16)
	NP Ukimath	Initiated (19)

Table 51. Present infrastructure for plastic waste management operations

Name of ULB	**Inventory of Infrastructure available for Plastic Waste Management Operation**				
	Plastic waste collection centres	**Plastic compactors and its capacity**	**Linkage with Plastic waste Recyclers**	**Material Recovery Facility (Available/Not Available)**	**Remarks**
NPP Rudraprayag	This ULB has been declared as a bin free city, therefore no open dustbin has available within the ULB. However, each household, commercial shop and hotels have separate dustbins for dry and wet waste.	One compactor is available with the capacity of 1.0 MT/day in the ULB.	02	Available	ULB have linkage with NEPRA Group and KK traders for the purpose of recycling and resale of plastic waste.
NP Agastmuni	This ULB has been declared as first Bin free	One compactor is available with the	02	Available	NEPRA Group and KK traders

	city in the district. However, separate dustbin is available at each household and commercial places for the management of dry and wet waste.	capacity of 1 MT/day in the ULB.			are available for the purpose of recycling and resale of plastic waste.
NP Kedarnath	No open dustbins are available as this ULB has been declared as Bin free city. 04 Secondary collection points, Moreover,76 households and 75 shops are allocated separate dustbins.	Not available	ULB have no linkage with any recyclers.	Not Available	Collected plastic waste has been sending to the Sonprayag for the further processing.
NP Tilwara	It's a bin free city. So, separate dustbins are available in each household and commercial shops for the purpose of dry and wet waste segregation.	One compactor is available with the capacity of 1.0 MT/day in the ULB.	02	Available	NEPRA Group and KK traders are available for the purpose of recycling and resale of plastic waste.
NP Ukimath	No open dustbins are available as this ULB has been declared as Bin free city. 01 Secondary collection points, Moreover, 1100 household and 346 shops are allocated separate dustbins.	A compactor with compacting capacity of 2.0 MT/day is in process of purchasing.	ULB have no linkage with any recyclers.	Not Available	Collected plastic waste has been sending to the Agastmuni MRF for the further processing.

Projected Population and Plastic Waste Generation in Rudraprayag District

Plastic waste in India has surged over the past 50 years and is expected to double again over the next 20 years. The growth rate of the Indian plastic industry is one of the highest in the world.

Forecasting waste quantities in the future is as difficult as it is in predicting changes of waste composition. As a general rule, the lower level of economic development, greater the change between generation and disposal. Census population data for the year 2001 and 2011 has been taken for population forecast. Decadal population and subsequent waste forecast *(For the year 2031)* has been done based on following presumptions:

- Arithmetic increase method has been used for the decadal population forecast, hence the rate of change of population with time is assumed to be constant.
- The per capita consumption of plastic waste has been taken as 11kg/annum. *(Centre for Science and Environment, 2019).*
- It is considered that 70% of total plastic waste consumption is discarded as waste. *(CPCB,2013)*
- 16 % yearly growth in per capita plastic waste consumption has been taken keeping in mind the changing waste paradigm and floating population. *(Centre for Science and Environment,2019)*

- Analysis includes population and waste generation estimations only for urban local bodies and does not include peri-urban and rural areas.

Table 52. Estimated Population and Waste Generation

ULB	Projected Population			Present/Projected Waste Generation (MTPD)		
	2021	2031	2041	2021	2031	2041
NPP Rudraprayag	16376	23439	30502	0.05	0.18	0.38
NP Agastmuni	7802	9047	10292	0.05	0.14	0.26
NP Kedarnath	742	872	1002	0.02	0.06	0.11
NP Tilwara	2828	3263	3698	0.03	0.07	0.14
NP Ukhimath	4149	4660	5171	0.02	0.05	0.09
Total	31897	41281	50665	0.16	0.51	0.98

Table 53. Decadal Change in Waste Generation

Name of ULB	Rate of growth (2021-2031) in %	Growth rate (2031-2041) in %
NPP Rudraprayag	27.21	11.02
NP Agastmuni	20.15	8.38
NP Kedarnath	20.56	8.56
NP Tilwara	20.00	8.31
NP Ukhimath	19.20	7.93

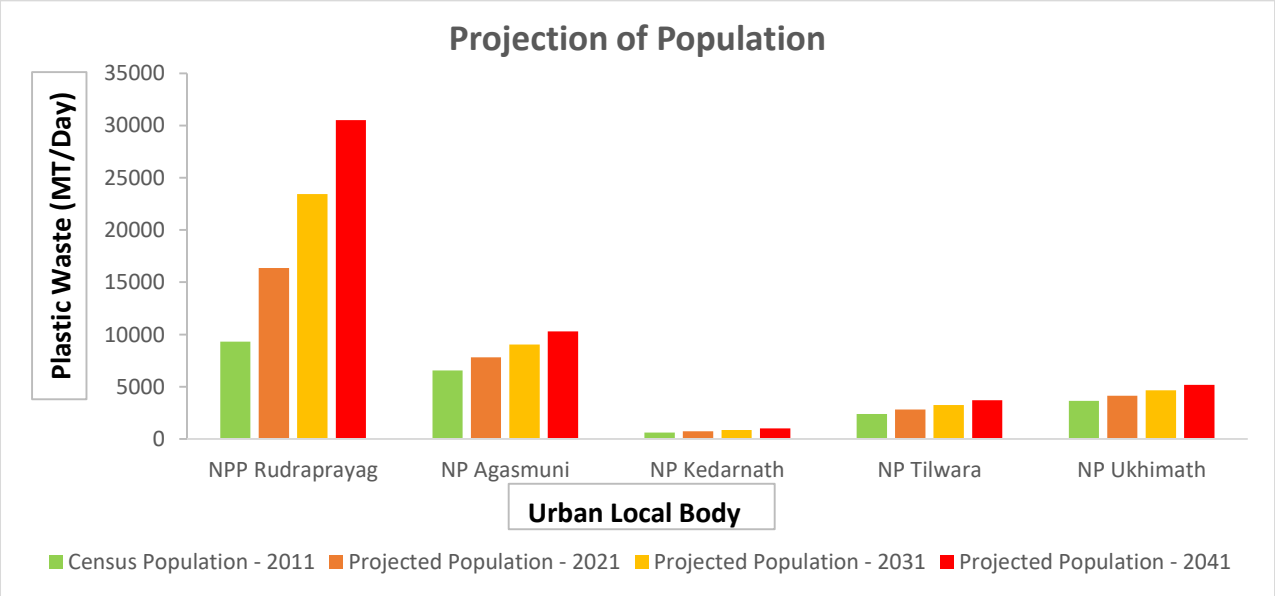


Fig. 6 Graphical representation of projected population

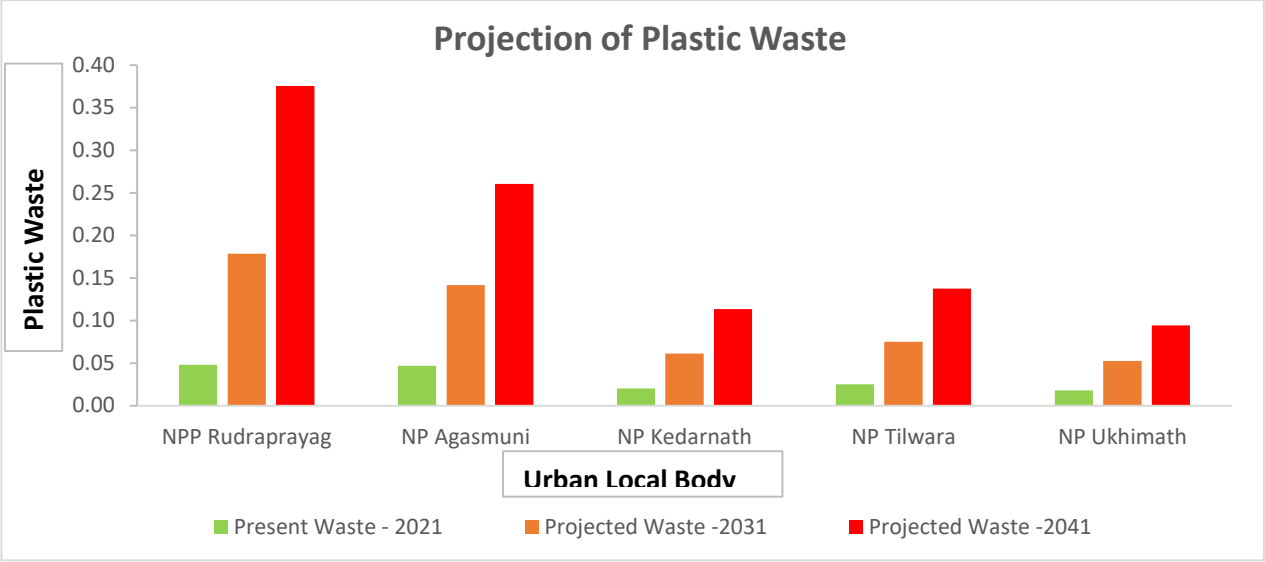


Fig. 7 Projected Plastic Waste Generation

Inferences from the Forecasted Data

- The amount of plastic waste generated will increase by 21-51% in the next two decades.
- plastic waste generation in the district is expected to increase by almost 0.35 – 0.82 MTPD in the coming decade.
- With increasing urbanization, the physical characteristics of waste will also change and a shape increase has been found in plastic waste.

ASSESSMENT OF URBAN LOCAL BODIES IN RUDRAPRAYAG DISTRICT

In order to push the Urban Local bodies to adopt effective waste management, an assessment of their waste management operations has been carried out (Table 55 & 56). The main objective of this assessment is to let ULBs know their present status regarding various waste management operations in Solid waste management, bio-medical waste management, C&D waste management etc. Based on the adopted methodology, few inferences have been drawn to let administration know about their performance in various indicators in the district.

Table 54. Assessment of urban local bodies in Rudraprayag district

Indicators	**Maximum Points**	**Urban Local Body**				
		NPP Rudraprayag	NPP Agastmuni	NP Kedarnath	NP Tilwara	NP Ukimath
Solid Waste Management						
Source Segregation	**4**	4	4	3	4	4
Collection	**4**	4	4	4	4	4
Segregated Waste Transport	**4**	4	4	3	4	4
Wet Waste Processing	**2**	2	2	2	2	2
Dry Waste Processing	**4**	4	4	2	4	2
Disposal	**2**	1	1	0	1	0
Inclusion of Informal Sector	**1**	1	1	0	1	0
Bio-medical waste Management						
Linkage with CBWTF *(Common Bio-medical Waste Treatment and Disposal Facility)*	**1**	1	0	0	0	0
Hazardous Waste Management						
Linkage with TSDF (*Treatment, Storage and Disposal Facilities)*	**1**	0	0	0	0	0
C&D Waste management						
C&D Waste Processing	**1**	0	0	0	0	0
E-Waste Management						
E-waste Collection and Linkage with Recyclers	**2**	1	1	0	1	1
General Information						
Innovation and use of indigenous Techniques	**2**	1	1	1	1	1

Enforcement of Bye-laws and Waste Management Rules, 2016	**2**	2	2	1	1	2
Total	**30**	**25**	**24**	**16**	**23**	**20**

Table 55. Final Assessment of Urban Local bodies of Rudraprayag District

Name of ULB	Score (out of 30)	Score Percentage (%)
NPP Rudraprayag	25	83.33
NPP Agastmuni	24	80
NP Kedarnath	16	53.33
NP Tilwara	23	76.66
NP Ukimath	20	66.66

Observations from data assessment

- Overall, NPP Rudraprayag is performing well in comparison to other Urban Local Bodies with better waste management operations.
- All the ULBs are performing well in waste collection operations but dry waste processing and disposal of waste still needs some attention in the district.
- NPP Rudraprayag, NP Agastmuni, and NP Tilwara has been performing well in waste disposal and recovery operations but NP Kedarnath and NP Ukimath have to focus more on waste disposal, recovery operations and need established linkage with NGOs/Recyclers/Private firms.
- All the ULBs has been declared as Bin-free city in the districts and they are performing well in source segregation except Kedarnath. Better waste management can be done by implementing regular IEC *(Information, Education, Communication)* activities and awareness programs to familiar the people about the importance of proper waste management.

ACTION PLAN

Action Plan for Solid Waste Management in the Rudraprayag District

Rudraprayag district is currently performing better waste management operations than other districts. The action plan focuses on the basic point, which forms the prerequisite for effective waste management. Each action point is in compliance with the guidelines of Solid Waste Management Rules, 2016. It is expected that the district would be able to scientifically manage their waste in a decadal timeline. The current action points must be addressed in a timeframe of 5-10 years considering the financial constraints (Table 56).

Focus Areas

- Revamping waste management infrastructure

Table 56. Action Plan for Solid Waste Management

Action Point	Concerning ULB	Strategy/Approach	Stakeholder Responsible	Purpose
Primary segregation (Segregation at source)	NP Kedarnath	• By allocating Separate Storage Bins for dry and wet waste in household and commercial areas. • Regular awareness campaigns, advertisement of stepwise process of waste management operations by road side hoarding and wall painting. • Manpower management. • By implementing Behavioural change Communication (BCC) strategy to the people who lives in the ULB. • By promoting home composting techniques for wet waste.	• Nagar Palika / Nagar Palika Parishad / Nagar Panchayat • Residents and NGOs	• Higher recovery of recyclable solid waste. • Hygienic environment for handling of solid waste. • Improvement of collection efficiency and better processing of solid waste.
Segregated waste transport	NP Kedarnath and NP Ukimath	• Optimizing waste management infrastructure (Collection trucks, trolleys). • Manpower optimization at recovery facility.	Nagar Palika / Nagar Palika Parishad / Nagar Panchayat	• To reduce open dumping of waste. • Reduction of historical waste. • To reduce contamination of ground water. Reduction of transportation charges.

Improvement of waste management infrastructure	NP Kedarnath, NP Ukimath and NP Tilwara	• Need to buy waste management infrastructure (Trolleys, Trucks, Collection van etc.) • By establishing Material Recovery Facility.	Nagar Palika / Nagar Palika Parishad / Nagar Panchayat	• Improvisation of the effective waste management To improve the process of segregation and resource extraction from waste.
Common centre for check the compost quality	All ULBs	• By establishment of a common compost quality check lab facility in the district.	District administration	To facilitate all the ULBs by a common compost quality check centre to measure the quality and improve the quality of compost.
Excavation and treatment of landfilled waste	All ULBs	• Converting bio-waste from landfill site into compost while plastic, glass etc., can be used for recycling. • By implementing landfill mining.	Nagar Palika / Nagar Palika Parishad / Nagar Panchayat	To mitigate environmental impact of waste. (Methane emission) Extraction of minerals or other solid natural resources from waste.
Scientific recovery and disposal of waste	NP Kedarnath and NP Ukimath	• Establishing a waste recovery facility • Construction of sanitary landfill. • Linkage with authorised recyclers and centralized treatment facilities.	• Nagar Panchayat • District administration	• To eliminate the risk of waste seeping underground. (Leachate) within the landfill. • To reduce the risk of environment or health hazards. • Reduction of Historical waste.
Cluster based approach to solid waste management	All ULBs	• By merging schemes from Central and State government department with Rurban Mission of Ministry of Rural Development.	• District administration • DPRO (District Panchayati Raj Officer)	• To club the villages in peri-urban areas of the town with the nearby solid waste management facility for effective waste management in rural areas. • To execute Rurban mission

				of Government of India.
Community participation for waste management	All ULBs	• Information, Education and Communication (IEC) activities in educational institutions. • Inter-Personal communication (IPC): School children and sanitation workers to spread awareness amongst people regarding waste management.	District Administration	• Social and Behavioural Change Communication. Cleanliness drive campaigns throughout the district.
Establishment of green protocol	All ULBs	By encouraging green protocol in local schools, public functions, IEC campaigns, sports events, annual temple festivals and other gatherings.	District Administration	• To prevent use of disposables and using alternatives like glass/Stainless steel etc. • To bring generation of non-biodegradable waste close to zero.

Vegetation suitable for rehabilitation of dumping sites

Besides having aesthetic value, vegetation (natural or planted) on a landfill site has an important role to play in soil formation, removal of contaminants and erosion control (Sadowsky, 1999). Moreover, vegetation may also be used in leachate treatment. Sometimes, vegetation over landfill sites may show signs of damage due to presence of landfill gas *(LFG)* in the root zone. In view of reconstruction of a suitable medium for landfill, afforestation, plantation, or re-vegetation might provide a capping that is deep and as favourable as to root growth to achieve desired plants' performance in getting over these degradations. In this context, locally available species could be hardened and resistant in reclaiming the waste dump problem (Table 57).

Table 57. Suggested vegetation for reclaiming landfill sites in the district Rudraprayag

Botanical Name	Local and English Name	Life form	Assimilating capacity	Altitude (m)	References
Quercus leucotrichophora A. Camus	Banj oak	Tree	Microbial biodegradation, binding, holding soils, and/or decreased leaching	1200-2400	Meenakshy et al, 1981
Bauhinia acuminata L	Kachnar	Tree	conversion of Hg to volatile chemical from groundwater	1150-1500	Chaphekar, et al., 1980
Adina cordifolia (Roxb.) Hook. f. ex Brandis	Haldu	Tree	conversion of Se and Hg to volatile chemical from groundwater	Upto-1500	Prajapati, 2012

Berberis aristata DC.	Kingore	Shrub	Metals, radionuclides, hydrophobic organics	1350-2000	Das, 1981
Berberis asiatica Roxb. ex DC.	Kilmora	Shrub	Adsorb' all the dissolved gases	1650-2400	Das, 1981
Cynodon dactylon (L.) Persoon	Dubla, Doob	Herb	Absorbs Arsenic and Fluoride from wastewater	700-2500	Chaphekar, et al., 1980

Action Plan for Rural Waste Management in the India

The Government of India as well as state government is looking up every Gram Panchayat to come up with a working system to manage solid waste. At the moment there are Gram Panchayats in Tamil Nadu, Andhra Pradesh, and West Bengal and in one or two GPs in Gujarat and Chhattisgarh which have created a robust and sustainable system to manage solid waste.

Presently in Rudraprayag district, the amount of solid waste generation from rural areas is unaccounted due to lack of waste management facilities and awareness. Some of the policies are propagated by both central and state government to come up with an array of practicable models for solid waste management in rural areas (Table 58).

Table 58. Policies undertaken for rural waste management in India

Current Policy	Sponsoring agency	Remarks
Decentralized Waste Management	Under Swachh Bharat Mission-Gramin (SBM-G)	Decentralized systems such as household compost and biogas plants shall be encouraged.
Community Sanitary Complex (CSCs)	Under Swachh Bharat Mission-Gramin (SBM-G))	Such complexes comprise of appropriated number of toilet seats, bathing cubicles etc. (Only where there is lack of space in the village for construction of household toilets).
Cluster Approach to Solid Waste Management	Rurban Mission of Ministry of Rural Development	It aims at developing infrastructure and livelihood opportunities in cluster of Gram panchayats that demonstrate economic growth potentials.
Community Participation through IEC (Information, Education and Communication) Activities	National Institute of Rural Development and Panchayati Raj	All the stakeholders need to plan for a series of IEC campaigns to educate the residents on how proper segregation at the household levels eases the entire process of managing waste at subsequent stages.

Action Plan for Bio-Medical Waste

With the onset of the pandemic, it has become clear that a proper healthcare system is need of the hour. It also provides the opportunity to improve biomedical waste management in the district. Moreover, during outbreaks such as covid-19, materials or substances which carry infection (fomites) acts as key vehicle for the transmission of the disease. Streamlining the bio-medical waste may help in reducing the infection and its transmission. This action plan provides holistic approach, which includes governance, infrastructure, training and immunization, services etc. to tackle the unprecedented growth in biomedical waste. Immediate action is required in some of the areas such as segregation and tracking of the waste generated etc. while other action points must be executed in due course of time (Table 59).

Focus Areas

- *Pre segregation of waste*
- *Tracking of bio-medical waste*
- *Linkage of major HCFs with* CBMWTF.

Table 59. Action plan for bio-medical waste

Action Areas	Purpose	Stakeholders
Governance		
Authorisation of all HCFs (Allopathic, AYUSH etc.) by Uttarakhand state Pollution control board (UKPCB).	• To ensure compliance with the biomedical waste management rules 2016. • To properly maintain and to improve the quality of health facilities in every HCFs.	Uttarakhand state Pollution control board (UKPCB)
Periodic inspection of HCFs (Health-care Facilities) by UKPCB (Uttarakhand Pollution Control Board).	To ensure proper segregation of Biomedical waste as per Biomedical waste management rules, 2016.	Uttarakhand Pollution Control Board (UKPCB)
Linkage of PHCs (Primary Health Centres), CHCs (Community Health Centres) and district level hospitals and with CBWTF (Common Biomedical Waste Treatment Facility).	To ensure proper disposal of biomedical waste as specified under biomedical waste management rules, 2016.	Health department
Linkage of ULBs with CBWTF.	To ensure segregation of biomedical waste from Municipal solid waste and thus its proper disposal as per Biomedical waste management rules, 2016.	All ULBs
Infrastructure		

Construction and maintenance of biomedical waste collection shed at district level HCFs, CHCs and PHCs.	To ensure proper collection and segregation of biomedical waste into different categories as specified under biomedical waste management rules, 2016.	Health department
Installation of Effluent Treatment Plants (ETPs) in district level HCFs and CHCs.	To ensure proper disposal and treatment of liquid effluent generated in the HCFs.	Health Department
Training And Immunisation		
State level and District level orientation programs for healthcare workers to sensitize them about effective biomedical waste management.	To ensure proper handling and segregation of biomedical waste in HCFs.	Health department
• Training on Biomedical Waste Management operators and pharmacists.	To properly maintain the information and keep well record of biomedical waste generated in every HCF of the district (specially in PHCs at rural areas).	Health department
Immunisation (Tetanus and complete doses of Hepatitis-B) of all hospital staff involved in biomedical waste management.	To immune the body to stay safe and to avoid any kind of infection while handling biomedical waste.	Health department
Services		
Establishing bins and bags at each generation points in HCFs with IEC posters displayed.	• To ensure the proper segregation at each generation point and to avoid mixing with MSW. • To spread awareness amongst the people related to Biomedical waste management.	Health department
Timely replacement of bags, BMW transfer to collection shed and then prompt lifting to biomedical waste treatment facility from the shed.	To ensure timely disposal of biomedical waste.	Health Department and Uttarakhand state Pollution control board (UKPCB).
Implementation of government policy/Initiative	• Need to focus on fully implementation on 'Swachh Bharat Abhiyan' (Clean India Mission) Launched by Prime Minister Shri Narendra Modi. • Focus on important initiative like 'Kayakalp' proposed by Ministry of Health and Family Welfare for high level of cleanliness, hygine and infection control.	

Bar code system for tracking bags and containers and use of GPS enabled systems in transportation vehicles.	To ensure tracking of biomedical waste collection, Transportation, disposal and recycling as specified under Biomedical waste management rules, 2016.	Health Department and UKPCB (Uttarakhand state Pollution control board).
Information		
Development of an IT-enabled database management system to keep inventory of waste collection, consumables supply, training programs etc. in HCFs (including PHCs in the district)	• To keep and well-organized records of biomedical waste generated in every HCF of the district (specially in PHCs at rural areas). • To ensure transparency in the biomedical waste management system up to primary level.	Health Department
Display details of authorization, treatment, annual report of all HCFs (Health-care facilities) on website.	To make the information open source and ensure transparency.	Health Department and UKPCB (Uttarakhand state Pollution control board).

Action Plan for Construction and Demolition (C&D) Waste Management

Increase in C&D waste generation is expected in decades to come due to rapid urbanization and modernising infrastructure (National Highways, railway line etc.). Hence, some basic facilities need to be developed to manage its growth. The action plan provides below (Table 60) provide a sustainable approach for the management of the C&D waste in compliance with the latest C&D waste management rules 2016.

Focus Areas

- *Establishment of dumping zones*
- *Framing of bye-laws*

Table 60. Action Plan for C&D Waste Management

Action Point	Strategy/Approach	Stakeholder Responsible	Purpose
Establishment of C&D waste deposition points / dumping zone for construction debris activities (building and road construction).	• Establishment of dumping zone such that it also caters for C&D waste management of Peri-urban areas nearby villages. • Proper collection and transportation systems should be set up to aid processing. Illegal dumping practices must be discouraged due to penalties on open dumping. • Establishment of dumping zone at suitable place (around in district road, village road) with a suitable distance from river / waterbodies.	•All ULBs and District Panchayati Raj officer (DPRO) •Public Works) Department (PWD)	•To ensure compliance with C&D Waste Management Rules 2016. •To proper collection, processing and management of C&D waste generated from constructed sites. •To abatement of adverse environmental impacts
Framing by-laws for C&D waste management.	• By-laws should be framed by each ULBs and DPRO as per C&D waste management rule for proper disposal of C&D waste in the district. • Provision of heavy fines should be done under these by-laws for illegal dumping of demolition waste such as excavated earth material on the banks of river or on the hill slopes.	•All ULBs and District Panchayati Raj officer (DPRO) •Public Works) Department (PWD)	To ensure compliance with C&D Waste Management Rules 2016. •
Proper management of C&D waste and Awareness programme.	• Managing C&D waste separately from municipal solid waste. • Establishment of Recycling / Treatment facilities. • Enhancing awareness and incentivization for efficient C&D waste handling and processing. • By organizing frequent awareness programme at ground level. • By advertise (roadside hoarding) about the process and efficiency of	•All ULBs and District Panchayati Raj officer (DPRO) •Public Works) Department (PWD)	• To ensure that C&D waste comes to the recycling plants as segregated input, and the recycled products are picked up for use in construction. •Popularization of recycled / treated C&D product to reuse for construction.

	product recycled / treated from C&D waste to reuse of new construction.		
Plantation in old dump sites.	• Plantation at old dumping zone should be done with the help of community participation to stabilize the slope over there.	• All ULBs and District Panchayati Raj officer (DPRO) • Public Works) Department (PWD)	• Established the slope at old dumping zones.

Action Plan for Hazardous waste management

Hazardous waste can be a potential threat to human health and environment. This makes it necessary to manage hazardous waste to minimize its harmful impact. At present in the district, hazardous waste is not handled in a scientific way (Table 61). This action plan provides some key areas in which the district needs to work to achieve effective hazardous waste management complying with latest hazardous waste management rules, 2016.

Focus Areas

- *Primary segregation of hazardous waste*
- *Linkage of ULBs with TSDF*

Table 61. Action Plan for Hazardous Waste

Action Point	Strategy/Approach	Stakeholder Responsible	Purpose
Linkage of ULBs with common TSDF (Treatment, Storage and Disposal Facilities) or Establishment of common collection centre	• All the ULBs of the district should establish linkage with nearby common TSDF or disposal facility to ensure proper disposal of hazardous waste to avoid its dumping in the landfill site. • At least one common collection facility should be setup in the district to collect domestic/commercial hazardous waste from the Rural/Urban areas of the district.	All ULBs & District Panchayati Raj officer (DPRO)	• To improve the collection and storage of hazardous waste. To ensure the proper treatment and disposal of domestic / commercial hazardous waste.
Training of sanitation workers regarding segregation of domestic/commercial hazardous waste	Training programme should be organised at State/District/ULB level for handling and segregation of domestic hazardous waste so that sanitation workers should not catch any kind of infection during its handing and its proper segregation could be possible.	State Government and District Administration	• To avoid the health effect from hazardous waste. To ensure segregation of domestic / commercial hazardous waste from municipal solid waste
Preparation of inventory for hazardous waste	• Establishment of IT enabled systems by SPCB to prepare inventory of hazardous waste. • SPCB should upload the inventory of the generation, collection, and disposal of both domestic and industrial hazardous waste on its website so that complete transparency is maintained in the management of hazardous waste in the district.	State Pollution Control Board	• To ensure compliance to Hazardous Waste Management Rule, 2016. • To ensure transparency in the biomedical waste management system up to primary level.

Characterization and Quantification of hazardous waste	• To ensure the segregation of domestic / commercial hazardous waste from municipal solid waste. • By continuous monitoring and proper maintaining the inventory of hazardous waste generation.	SPCB/Industry/ District administration	• To improve the management hazardous waste To estimate the amount of hazardous waste generated in the district.
Integrated sustainable waste management	• All citizens should be exposed to appropriate waste management system • Prepare a model for waste management which should ensure safe removal of waste. • By maximizing the benefits, lower the costs and optimize the use of resources, taking into account, equity, effectiveness and sustainability.	SPCB/ District administration	To appropriate waste management system for environmental health reasons.

Action Plan for E-Waste Management

Due to lack of basic waste management operations for E-waste, its quantity cannot be determined in the district. This may be due to lack of awareness amongst the people regarding E-waste as well as lack of concern by district administration. E-waste needs to be streamlined in the current waste management operation, moreover a detailed framework must be developed for its management.

Focus Areas

- *Inventorization of e-waste generated*
- *Establishment of e-waste Collection Centres*
- *Authorization of e-waste pickers*

This action plan discusses key areas where intervention is needed to achieve effective waste management in compliance with E-waste management rules, 2016. Some of the action needs to be addressed immediately such as establishment of collection centre etc. while others can be initiated with the due course of time (Table 62).

Table 62. Action Plan for E-Waste Management

Action Point	Strategy/Approach	Stakeholder Responsible	Purpose
Appropriate collection and segregation of E-waste	• Collection centre should be established for all ULBs in such a way that they could also cater the collection from nearby rural areas. • A Toll-Free Number must be issued for the collection of E-waste	All ULBs / District administration	• To ensure proper collection and segregation of E-waste from municipal solid waste. Capacity building of stakeholders to promote effective E-waste management.
Authorization of E-Waste Pickers	Authorization of E-waste pickers should be done. For that, Identity cards should be issued to them by district administration and urban local bodies.	ULBs / District administration and	• To avoid illegal trading and processing of e-waste. To increase the responsibility of waste pickers of effective collection and segregation in respective areas.
Linkage of ULBs with authorized recyclers / Dismantlers	All the ULBs in the district should establish linkage with any of the five authorized E-waste recyclers.	All ULBs	To ensure proper recycling if possible and if not then proper disposal as per E-waste management rule 2016.
District level Awareness campaign	• Promoting Information, Education and Communication (IEC) activities in educational institutions (Schools, Colleges etc.) • Promoting Awareness programmes under Digital India Initiative (Initiated by Ministry of Electronics and Information	District administration	• Promoting behavioural change in public. • Improvement of E-waste management. • To aware people about effective recycling and reusing of E-waste.

	Technology) about alternate methods of disposing E-waste.		
Popularization of product made from E-waste	• Refurbishment, reuse and remanufacturing of E-waste. • Establishment of road side hoarding for advertising about efficiency of product made from E-waste.		• To reduce the cost of electronic product To ensure the people about efficiency of product made from E-waste.
Extended Producer Responsibility	• Random sampling of electrical and electronic equipment's placed on market to monitor and verify the compliance of RoHS (Restriction of Hazardous Substances) provisions as per the guidelines of Central Pollution Control Board (CPCB). • "E-waste Return" Programme should be initiated to incentivize people and bring about behaviour change.	State government	• Proper Collection and Disposal of E-waste • Channelization of e-waste generated from the "end-of-life" products to ensure environmentally sound management

Action Plan for Waste Water Management (STPs)

Scientific and technological interventions in wastewater management are lacking in most of the ULBs of Rudraprayag district. All ULBs rely on conventional treatment of wastewater which has become obsolete and leads to environment degradation. However, some policies are promulgated in the district to revamp the liquid waste management in the district. This action plan focusses on addressing concerns of each ULB pertaining to the policies and design sanctioned by the respective administration (Table 63).

Focus Areas

- *Decentralized waste water management*
- *Phytoremediation for natural treatment*

Table 63. Action Plan for Waste Water Management (STPs)

Action Point	Concerning ULB	Strategy/Approach	Stakeholder Responsible	Purpose
• Treatment of waste water • To maintain the good water quality and keep safe the waterbody	All ULBs	• Establishment of New STPs • Biological, Chemical and Sludge treatment can apply to treat the waste water. • By continuous monitoring of STPs.	ULBs/ Jal Sansthan	• For the treatment of sewage water and to make it fit for safe disposal, agricultural use or domestic use in toilets etc. Sewage usually contains a high quantity of organic and inorganic wastes. So, it is essential to treat sewage before it enters into any water body.
Upgradation of storm surge water treatment plant	NP Rudrapr ayag	• A proposal could be made for the upgradation of storm surge water treatment.	ULBs/ Jal Sansthan/ Jal Nigam	To increase the treatment capacity of storm surge water.
Continuous Effluent Monitoring station	NP Rudrapr ayag	• Self-monitoring mechanism in the form of online continuous effluent monitoring system.	• Jal Sansthan • State Pollution control board	• To ensure that the STPs meet out the prescribed standards as per Environment Protection Act, 1986.
Decentralized waste water management under AMRUT (Atal mission for Rejuvenation and Urban transformation) by FSSM (Faecal Sludge and Septage Management system)	All ULBs	• In line with National FSSM policy, each state is expected to develop and issue an FSSM implementation strategy and plan guideline. This may be integrated with overall city land use planning. • Capacity building and training on FSSM (at City level) to build their personnel capacities and organizational systems for delivery of sanitation services.	Ministry of Housing and Urban development Government of India	• Promoting community-planned and managed faecal sludge and septage management for group of households. • Rehabilitation of old sewerage system. • To augment limited treatment capacity. Recycling and reuse of waste water for beneficial purposes.

City Sanitation Plan under National Urban Sanitation Policy	All ULBs	• Enhance synergy among municipal government agencies, the private sector, NGOs and others. • Increase funding from sources other than municipal government (such as from the national and provincial governments, donor agencies, the private sector)	Ministry of Housing and Urban Development, Government of India	• Citywide Sanitation Sector development. • Awareness generation and behaviour change in field of Sanitation. Sanitation and safe disposal of waste.

Phytoremediation as a Mitigation Measure *(For Domestic Waste Water)*

With removal of some biotic and abiotic pollutants (by absorbing these pollutants), certain plants, can help in the natural treatment of domestic waste water (Table 64).

Table 64. Phytoremediation using some important plants for domestic waste water

Botanical name	Local name	Altitude (m)	Remarks
Azolla pinnata R.Br.	Azolla	Upto 1000	Used for cleaning of sewage and degrades diesel fuel and absorbs mercury and cadmium
Salix babylonica L.	Willow	1400-2000	Improve the quality of ground water by absorbing ammonical nitrogen and heavy metals
Canna indica L.	Canna	1800-2000	Used for removal of ammonical nitrogen from sewage
Jacaranda mimosifolia D.Don	Jacarnda	500-2400	Anti-microbial action against E.coli and Staph bacteria
Typha domingensis Pers.	Southern Cattail	upto 1,500	Reduces bacteria from water and absorbs Al, Fe and Zn from sewage.

Action Plan for Water Resources Management and Ground Water Extraction/ Contamination

Water Resources and Ground water management requires an integrated approach from different departments such as District administration, Panchayati Raj, Jal Sansthan, Jal Nigam, Payjal Nigam, Forest Department etc. Each department is expected to work in tandem with each other to achieve effective management of resources, be it land or water. The action plan focuses on the areas, which form the prerequisite for effective water resource management. Each action point is in compliance with the guidelines under Water (prevention and control of pollution act, 1974), (Amendment) Rules 2021 of water resource management act, 1986. The current action points must be addressed in a timeframe of 5-10 year considering the financial constraints (Table 65 & 66).

Focus Areas

- *Mapping of water scarce areas*
- *Encouraging the use of organic fertilizers*
- *Crop diversification*

Table 65. Water Resources Management

Action Point	Strategy/Approach	Purpose
Integrated water resources management (IWRM) at River basin level	By Considering basin/sub basin as a basic unit for planning and management.	To achieve water security for all purposes, managing risks and to mitigate disasters
River Basin Master Plan	By analysing River Basin Characteristics	Periodic review of hydrological conditions prevailing over a basin Identification of protected areas
Mapping of water scarce areas in a district	• By using modern mapping tools such as GIS (Geographical Information System) and Remote sensing • By setting up an interdisciplinary framework consisting of Local institution and empowered government agency	• To get estimate of vulnerable areas in the district.
Assessment of water Resources in various river basin	Using Modern technology and Hydrological modelling	To collect reliable data To assess water resources potential and analysing water requirements for various uses,
Public Awareness and use of low-cost technologies	Using field application methods such as Drip Irrigation/Micro Sprinkler Irrigation systems in water scarce areas. This can be achieved by bringing government subsidies in this area as the local people needs incentives to up bring this modern technology.	For better water application efficiency
Integrated Rural area Programme (IRAP)	By bringing together all the programmes of different ministries as well as rural employment and development programme into one for effective collaboration and planning.	• For constant interactive relationships between different departments

		Location specific programmes can be drawn up locally under this overall programme.

Table 66. Ground Water Management

Action Point	**Strategy/Approach**	**Purpose**
Multidisciplinary Approach.	By integrated vision and coordination amongst different departments (need to Nexus between groundwater, agricultural policy, urban infrastructure and energy consumption).	For groundwater sustainability
Mapping of aquifer at micro level	By Maintaining an Aquifer information and Management system	To quantify the available ground water resources To formulate plan appropriate to the scale of demands and aquifer characteristics.
Artificial recharge of Ground water	• By demarcating and giving special attention on natural groundwater recharge zones. • By using broad leaf plants to improve the moisture content in the soil and thereby increasing the groundwater level and water holding capacity of soil. • Improving the scale of work done through various schemes such as MNREGA, Jal Shakti Abhiyan which will help develop indigenous recharge methods (Such as, Chal-khal, small ponds, khadins etc.). • Focus on such action like 'Cath the Rain' techniques to store the rain water and recharge the groundwater.	• To ensure sustainability of ground water resources • To ensure the quality of recharge to prevent possible contamination
Identification of Non-point sources of Pollution (Pollution resulting from land runoff, precipitation, drainage, seepage etc.)	• Need to Groundwater surveying as soon as possible. • Controlling soil erosion by planting more trees and covering bare soil with vegetation. • Constructing wetlands.	• Non-point source pollution is a leading cause of deteriorating water quality as when the runoff moves, it picks up and carries away natural and human-made pollutants finally depositing them in lakes, rivers and groundwater.
Mitigating Groundwater Contamination	• Reducing the use of pesticides and fertilizers. • Encouraging Organic farming in the area by organising various IEC (Information, Education and Communication) campaigns.	• To ensure the ground water quality of an area. • To reduce health hazards caused due to contaminated water.

Action Plan for Air Quality Management

As the anthropogenic activities in the district are mainly responsible for increased levels of pollutants in the region, so the participation of various institutions along with the local community is desired. The first and the foremost thing is establishing air quality monitoring station in the district. The action plan provided below deals with all the aspects, which are necessary to solve the issue (Table 67).

Focus Areas

- *Air quality monitoring*
- *Control of forest fires*

Table 67. Action Plan for Air Quality Management

Action Areas	Strategies/Approach	Stakeholders	Purpose
Air quality monitoring	Ambient air quality monitoring stations can be installed in all the urban centres and other identified areas such as construction sites after manual air quality monitoring.	Uttarakhand state pollution control board (UKPCB)	To identify the hotspots within the district and further development of mitigation measures for those areas.
Solid waste management and mitigation system	• Door to Door collection of waste in the urban areas and provision of dry waste collection from rural areas within the district. • After implementing proper solid waste management mechanism, provision of heavy fines should be made on open burning of waste. • Need to organized awareness programme about the negative impacts on health due to waste burning.	All ULBs and District Panchayati Raj Office (DPRO)	Promoting alternatives to open burning to reduce black carbon emissions and to prevent the release of cancer-causing compounds and other toxic substances especially in urban areas.
Control over forest fires	• Providing the forest department adequate manpower and machinery to control forest fires. • Proper coordination between various departments involved in this operation. • Proper inspection of civil forests and forests under van panchayats by training the personnel engaged in the maintenance of these forests. • Development of mixed forest by planting indigenous broadleaf plants which maintains moisture in the soil and reduce the chances of fire.	Government of Uttarakhand and District Forest Department	To reduce harmful emissions due to massive forest fires in the district.
Vehicular traffic management	• Establishment of vehicle pollution check centres to analysed the emissions and identify the most contaminant vehicles by the periodic observation. • Checking adulteration of fuel. • Promoting intercity and intra-city public transportation with green fuel alternatives such e-buses & rickshaws etc.	• Department of Police • Transport Department • Public works department	• To reduce emissions caused by vehicles.

	• Paving of road shoulders especially in urban areas. • Prefer bicycle, public transports for short/local journey and avoid using private vehicles to reduce the fuel consumptions.		
District level action plan for air pollution	A district level task force with some experts can be formed for air quality management in the district.	District Administration	To improve existing air quality.
Awareness on air quality	Mass awareness can be promoted with IEC activities by involving institutions such as schools and colleges for this purpose.	District Administration	To promote awareness among the masses regarding the issue.
Complaint redressal system	Online complaint registration and redressal system should be formed at the district level to register complaints regarding air pollution issues.	• UKPCB • District administration	• To sort out grievances registered by citizens

Phytoremediation for air pollution in the district

Today, air pollution is one of the most important aspects of environmental study. A natural way to combat and /or to minimise air pollution is plantation preferably with locally available species. However, all plants do not show the same response to a particular type of pollutant. Hence, plants also differ to remediate different type of air pollution. Plant species need to be selected in view of potential of different plants, viz., dust dispersal, carbon sequestering, etc. In view of these aspects, each plant species has its different value in minimising and enriching air quality status in a geographic entity (Table 68).

Table 68. Some suitable plant species for air pollution management

Botanical name	Local Name	Altitude	Assimilating capacity	References
Chenopodium murale L	Bathua	1000-2200	Remove volatile hydrocarbons	Awadhi et al, 2012
Brassica oleracea L.	Sarso	1000-2000	Uptake Cd, Sn, Zn and Pb from air particulate through leaves	Gawronski, et al, 2017
Brassica spp.	Kali Sarso	800-2200	Absorb So_2 and No_2 from polluted air	Gawronski, et al, 2017
Vicia faba L.	Broad bean	900-1400	Remove volatile hydrocarbons	Ali et al, 2015
Zea mays L.	Corn	500-1800	Remove phenolic compounds	Sandhu et al, 2007

Action Plan for Noise Pollution Management

Noise pollution is not a big issue in the district. It prevails only at festive times, Char Dham yatra and public gatherings. However, actual noise level cannot be ascertained due to lack of monitoring station. This action plan focuses on key aspects that requires minimal financial interventions and maximum management (Table 69).

Table 69. Action Plan for Noise Pollution Management

Action Areas	Strategies/Approach	Stakeholders	Purpose
Noise level monitoring	• Noise monitoring studies need to be done in the district especially within the urban centres within the district by manual monitoring. • In the areas identified as hotspots, continuous monitoring stations should be set up.	Uttarakhand state pollution control board (UKPCB)	To recognize the current situation of noise levels in the district and identify the hotspots
Traffic management	• Signboards should be placed at sensitive locations (Hospitals, Schools etc.) in the towns within the districts • Green belts can be formed along the roads in the urban areas to reduce noise levels • If required silent zones should be established in the district.	• District Administration • Public Works department and ULBs	To ensure noise level within permissible limits
Complaint redressing system	Online complaint registration and redressal system for noise pollution should be made which can be used by citizens, Traffic police, ULBs, and state pollution control board.	District Administration	To sort out grievances registered by citizens
Mass Awareness	Mass awareness campaigns must be organized with the help of IEC activities by taking the help of institutions such as schools and colleges for this purpose	District Administration	To promote awareness among the masses regarding the issue

Mining Activity Management Plan

Although the cases of illegal mining practices are minimal in the dsitrict, precautionary measures are necessary keeping in mind the future aspects. Further, it is also necessary to be aware of the cases of illegal mining, which remains unregistered so far. The action plan provided below mainly emphasize on areas, which includes monitoring of the mining operation by using the latest technologies as per the sustainable sand mining guidelines 2016 (Table 70).

Focus Areas

- *Identification of hotspots*
- *Digitization of trading process*

Table 70. Mining Activity Management Plan

Action Areas	Strategies/Approach	Stakeholders	Purpose
Scientific study for suitable mining place	Scientifically field surveying.	Geology and Mining Department	To ensure the sustainability & protection of environment.
Monitoring of mining activity	• A district-level task force should be formed to monitor mining activities and to conduct river audits and surveillance. • For the rivers marking the boundaries with other districts, a combined task force should be formed to monitor mining activity in the river.	District Administration	To ensure sustainable mining activity within the district.
System for Online purchase and sale of Sand and Other RBMs	An online system should be made at the state or district level for e-auctioning the mines to ensure transparency in the system.	State Government and District Administration	To ensure compliance to Enforcement and Monitoring guidelines for Sand mining, 2020.
Identification of hotspots for illegal mining	The district task force should identify the possible hotspots for illegal mining through surveillance and patrolling.	District Administration	To have check on the mining activities in the district.
Community participation	A toll-free number must be issued for citizens in the district to register any complaint against any illegal mining practices as identified by them in their vicinity	District Administration	• To understand local community's willingness in curbing illegal mining from the area. • To have local check on the illegal mining activities in the district.

Action Plan for Rejuvenation of Waterbodies

Rejuvenation of water bodies requires an integrated approach from different departments such as District administration, Rural Development department, Irrigation department, Jal Sansthan, Jal Nigam, Forest Department, NGOs, etc. Either it is land or water, each department is expected to work in tandem with each other to achieve effective management of resources. Rudraprayag district administration has already undertaken the task of rejuvenating two rivers using various methods. Aim is to revive the flow of the rivers and to restore their ecology. This action plan provides a holistic approach, which includes scientific interventions as well as convergence activities (Table 71).

Table 71. Action Plan for Rejuvenation of Waterbodies

Action Point	**Strategy/Approach**	**Purpose**
Identification and preparation of database of waterbody need to be rejuvenate	• Surveying of waterbodies. • Geospatial technology.	• To get information (water quality, area of water body, area depended/affected by any waterbody) easily regarding any waterbodies.
Spring-shed and Stream shed management	• By Constructing loose boulder check dams. • Encouraging Information, Education and Communication (IEC) activities.	• To improve water resource sustainability. • To enhance water discharge from springs and rivers.
Convergence Activities	By personally or community engagement to rejuvenate or maintain the waterbodies.	Insuring Community participation.
Prohibition of disposal of Municipal Plastic waste and Biomedical waste (Specially in flood plain zones)	• Awareness and behavioural change activities. • Provisions of heavy fine for those found throwing garbage in rivers.	• To maintain ecological balance of the water body. • To stop groundwater pollution.
River Catchment/Basin Management	Participatory and self-management institutional framework for administering the catchment with a combination of engineering, social and scientific management.	Reducing levels of potential contaminants in raw water.
Plantation in Flood plain zones (FPZ)	Vegetation that acts as natural resistant to soil disturbances and standing water must be encouraged.	• To reduce shoreline erosion. Act as natural barriers to dissipate waves and back-lying areas from flooding.

Action Plan for Plastic Waste Management

Plastic waste causes a variety of environmental problems. When it is left or thrown into the open environment, it may be dangerous to wildlife, animals and humans. There is evidence that the toxic chemicals added during the manufacture of plastic, transfers to animal tissue, eventually entering into the human food chain. Moreover, plastics clog sewers and provide breeding grounds for mosquitoes, pests, etc. Plastic bags can increase the transmission of vector-borne diseases like malaria, cholera, etc. According to one estimate, more than one-third plastic on this planet is burned. This causes heavy metals, persistent organic pollutants (POP), and other toxic chemicals into the air.

Rudraprayag district is currently in an intermediate phase of plastic waste management operations. This action plan focuses on the basic issues which form the prerequisites for effective waste management. Each action area is in compliance with the guidelines of 'Plastic Waste Management Rules, 2016'. The current action areas need to be addressed in a timeframe of 5-10 years considering the financial constraints as explained in Table 72.

Table 72. Action Plan for Plastic Waste Management

Action Point	Concerning ULB	Strategy/Approach	Stakeholder Responsible	Purpose
Source segregation	NP Kedarnath and NP Ukimath	• By ensuring the use of separate bins to each household, street vendors and other shopkeepers in Urban areas. • Distribution of separate bins to all households and shopkeepers in rural areas under Swachh Bharat Mission Gramin should be ensured. • Mass awareness programmes regarding source segregation with the inclusion of institutions such as schools and colleges.	All ULBs, DPRO (District Panchayati raj Officer), Village Panchayats	• To ensure better efficiency in waste processing • Higher recovery of resources.
Effective collection and segregated waste transport	All ULBs	• Training waste pickers and providing them proper equipment suitable as per the topography of the area for door to door collection in urban areas. • Establishing plastic waste collection centres in rural areas where door to door collection is not possible. • Provision of separate vehicles is done for dry and wet waste to ensure utilisation of manpower. • ULBs can establish linkage with the NGOs working in this field for effective waste collection in the urban areas.	All ULBs, DPRO (District Panchayati Raj Officer), Village Panchayats	• To reduce open dumping of waste • To ensure optimum utilisation of manpower • To ensure compliance with plastic waste management rules 2016

Improvement of waste management infrastructure	NP Kedarnath , NP Ukimath and NP Tilwara	• Need to buy waste management infrastructure (Trolleys, Trucks, Collection van etc.) • By establishing Material Recovery Facility.	Nagar Palika / Nagar Palika Parishad / Nagar Panchayat	Improvisation of the effective waste management To improve the process of segregation and resource extraction from waste.
Linkage of ULBs & other collection centres with recyclers/ cement plants / Public Works Department	NP Kedarnath and NP Ukimath	• Concerning ULBs should establish linkage with any recyclers as other ULBs of the district already have linkage with some of the recyclers. Plastic waste collection centre to be started in rural areas should also be linked with recyclers. • Plastic waste can be used in road construction for this ULBs should coordinate with the construction agencies such as Public Works Department.	All ULBs, DPRO (District Panchayati raj Officer),	To avoid open dumping of plastic waste. To ensure reuse and recycle of plastic waste.
Implementation of Extended Producer Responsibility (EPR) through producer/Brand owner	All ULBs	ULBs can ask the manufacturers collectively or individually in line with the principle of extended producer responsibility (EPR) to provide the required finance to establish plastic waste collection centres.	All ULBs	To reduce the workload of ULBs
Material recovery facility	NP Kedarnath and NP Ukimath	• Establishing a waste recovery facility • Construction of sanitary landfill. • Linkage with authorised recyclers and centralized treatment facilities.	Nagar Panchayat District administration	To eliminate the risk of waste seeping underground. (Leachate) within the landfill. To reduce the risk of environment or health hazards.
Community participation for waste management	All ULBs	• Information, Education and Communication (IEC) activities in educational institutions. • Inter-personal communication (IPC): School children and Sanitation workers to spread awareness amongst people regarding waste management	District Administration	Social and Behavioural Change Communication Cleanliness drive campaigns throughout the district
Establishment of Green Protocol	All ULBs	Encouraging green protocol in local schools, public functions, IEC campaigns, sports events, annual temple festivals and other gatherings.	District Administration	To prevent use of disposables and using alternatives like glass/Stainless steel etc. To bring generation of non-biodegradable waste close to zero.

CONCLUSION

Environmental planning and management holds much importance in the Rudraprayag district. Each aspect related to environment planning whether it is waste management operations, surface and ground water management, air pollution requires intervention from multiple departments.

Currently, the waste management operations in the district, particularly solid waste management is close to optimum in the district. With the district achieving 100% source segregation, door to door collection and manual sweeping, the next step must contain efficient management of dry waste so that minimal amount of waste reaches the dump site. Keeping in mind the health aspects, the domestic hazardous waste and electronic waste also needs to be streamlined in both primary and secondary waste management operations. Formalisation and authorisation of waste pickers will help realising the actual quantity of such waste generated in the district. Biomedical waste management has been obsolete in the district as only deep burial method is used to dispose this waste. Covid pandemic has already challenged our healthcare system and this has led to increase in biomedical waste from healthcare facilities. Hence scientific management of biomedical waste is desired in near future which will require equipment's and machinery for handling apart from segregation at source. Liquid waste water from the drains has been tapped and treated at the storm surge water facilities. This has resulted to reduction of effluent in the rivers. However, the households and commercial establishments still rely on conventional method of Septic Tank+soak pit to dispose of the waste water. Scientific intervention in managing this liquid waste is required in near future as the conventional way may deteriorate the ground water in the district. Air pollution level cannot be ascertained in the district at present due to unavailability of monitoring station in the district. But it is believed that the floating population and increased vehicular influx during the yatra season may already have started deteriorating the air quality in the district. One big push should be to setup a permanent air quality monitoring station in the district to at least ascertain the prevailing air quality in the district. The district has abundance of water resources be it rivers, ponds, springs etc. Moreover. artificial recharge through amalgamation of indigenous and modern techniques is already underway in the district to cater the growing water demand in the district. Flood plains of Alaknanda and Mandakini rivers have been a source of sand from the time immemorial. Sand mining is thus prevalent in the district. Minimal cases of illegal mining have been registered, still continuous monitoring and electronic surveillance is desired in near future.

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