DISTRICT ENVIRONMENTAL PLAN

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

TEHRI GARHWAL

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

CONTRIBUTORS

Director, GBP-NIHE	Project Coordinator
Dr. J.C. Kuniyal, Scientist 'G' & Head CEA&CC, GBP-NIHE	Principal Project Investigator
Dr. G.C.S Negi, Scientist 'G' & Head CSED, GBP-NIHE	Co-Project Investigator
Dr. I.D. Bhatt, Scientist 'F' & Head CBCM, GBP-NIHE	Co-Project Investigator
Dr. Sumit Rai, Scientist 'C', GBP-NIHE	Co-Project Investigator
Dr. Kapil Kesarwani, Scientist 'C', GBP-NIHE	Co-Project Investigator
Dr. Dalbeer Singh Pharswan, Project Scientist, GBP-NIHE	Team Member
Mr. Tapan Ghosh, Researcher, GBP-NIHE	Team Member
Mr. Manav Sharma, Researcher, GBP-NIHE	Team Member
Mr. Pramod Joshi, Field Surveyor, GBP-NIHE	Team Member
Administration	
District Magistrate, Tehri Garhwal	Chairperson
Divisional Forest Officer, Tehri Garhwal	Member Secretary

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 Tehri Garhwal 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

The present 'District Environment Plan' has been an outcome of coordinated efforts put together by different stakeholders from top to bottom in the state as well as in the district. At the outset, we thank the Chief Secretary, Uttarakhand Government, and Shri S.P. Subudhi, Member Secretary, UKPCB. We thank the Director, G.B. Pant National Institute of Himalayan Environment (GBPNIHE), Kosi-Katarmal, Almora for providing necessary facilities, instrumental support and encouragement. We are also thankful to Chairman & District Magistrate (DM), Divisional Forest Officer (DFO), Member Secretary, for their time to time valuable inputs in the formulation of the DEP. We acknowledge all the support received from different departments including the DM office, UKPCB, Nagar Palika Parishad (NPP), Forest department, Health department, Jal Sansthan, Irrigation Department, Mining Department, Regional Transport Officer (RTO), etc. for providing the information in a very satisfactory manner. The guidance and support from MoEFCC and the Government of Uttarakhand remained a constant source of inspiration at stages of this work. We thank and acknowledge all officers/ staff who could directly or indirectly contribute their valuable inputs in completing the work. We also extend our thanks to all the colleagues who made this work a memorable and worthwhile experience.

In the last but not least, our especial thanks go to Uttarakhand Pollution Control Board (UKPCB), Government of Uttarakhand, for financial support (Letter No. UKPCB/HO/Gen.183-431/2020/2156-415, dated 05/08/2020) to conduct the study in the 13 districts as well as the state of Uttarakhand.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

AMRUT	- Atal Mission for Rejuvenation and Urban Transformation
APL	- Above Poverty Line
AR6	- Sixth Assessment Report
As	- Arsenic
ASSOCHAM	- Associated Chambers of Commerce and Industry of India
BaP	- Benzo(a) Pyrene
BMWMIS	- Biomedical Waste Management Information System
BPL	- Below Poverty Line
C	- Carbon
C_6H_6	- Benzene
C&D waste	- Construction and Demolition waste
CACMP	- Catchment Area Conservation and Management Plan
CAMPA	- Compensatory Afforestation Fund Management and Planning Authority
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 Organization
Cr	- Chromium
CSC	- Community Sanitary Complex
CT	- Contour Trench
Cu	- Copper
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
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
MMT	- Million Metric Tons
MoEFCC	- Ministry of Environment, Forest and Climate Change
MoF	- Ministry of Finance
MoUHA	- Ministry of Urban and Housing Affairs
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
NGO	- Non-Governmental Organization
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
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
PM	- Particulate Matter
PT	- Percolation Tank
PUC	- Pollution under Control
PWD	- Public Works Department
QPD	- Quintal per Day
RBM	- River Bed Mineral
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
SLWM	- Solid and Liquid Waste Management
SO_2	- Sulphur Dioxide
SPCB	- State Pollution Control Board
SSMG	- Sustainable Sand Management Guidelines

STP	- Sewage Treatment Plant
TPD	- Tons per Day
TSDF	- Treatment Storage and Disposal Facilities
UKPCB	- Uttarakhand Pollution Control Board
ULB	- Urban Local Body
UNDP	- United Nations Development Programme
WHO	- World Health Organization
µg	- Microgram

EXECUTIVE SUMMARY

Being a gateway to major tourist and pilgrimage destination, Tehri Garhwal district needs to give due consideration to environmental planning in the areas of waste management, water and air pollution, changing land use, etc. Environmental and climate change issues are numerous and complex. Economic and population growth have been the factors that need to be highlighted to explain the increasing stress imposed by human interferences on the natural environment.

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 an Environment Plan for the District of Tehri Garhwal. Detailed deliberations were carried out to devise the action plan focusing on explicit thematic areas which are as under:

- ***Waste Management Operations:*** Despite of minimal scientific interventions in waste management operations, Tehri Garhwal district is performing well in waste collection, processing and disposal. Some of the ULBs have been awarded for their splendid performance in managing the solid waste.
- Based on our estimation, as the populations rise, both solid waste and plastic waste generation is expected to increase by 20 MTPD and 16 MTPD respectively by 2040. Moreover, it is also assumed that waste composition will also change with rapid urbanization and change in habits and attitude.
- Scientific resource recovery operations in near future is desired for optimal solid waste management in the district.
- Other wastes such as hazardous waste, e-waste are not segregated and exist as mixed waste collected from the domestic households and commercial establishments. No mechanism has been developed for their scientific handling.
- Hazardous waste generated from the industries in the district is inventoried by State Pollution Control Board. It is sent to Treatment, Storage and Disposal facility (TSDF) at Roorkee for further processing.
- Plastic waste, after segregation and compaction, is being sold to local rag pickers.
- Based on our assessment, NPP Munni-ki-Reti has better waste management operations in the district. The ULB has been awarded several times for its exemplary performance.
- ***Biomedical Waste Management:*** Deep burial method is preferred for the disposal of bio-medical waste in Tehri Garhwal district. Small quantity of waste is lifted by CBMWTF in Roorkee. It has been found that many HCFs haven't been authorised by UPCB which hampers the biomedical waste management in the district.

- ***Construction and demolition waste management:*** Most of the C&D waste generated is used locally to fill the low lying areas and for repairing of local roads. Apart from this, no formal strategy has been prepared by the ULBs for C&D waste management in the district.
- ***Waste water Management***: At present, 09 sewage treatment facilities are operational in the district primarily in the urban dwellings of the district. More than 50% of households in Muni ki Reti, Tapovan and Devprayag have been connected to STP through extensive sewer line network. Apart from waste water treatment, other works such as plantation is also being performed in the banks of the river to provide the aesthetic value.
- ***Air and Noise Pollution:*** Pollution levels in Tehri Garhwal district are hard to ascertain as there is no instrumentation or facility available to get the real time air quality. Every year forest fires cause immense loss to biodiversity and deteriorate the air quality. No district level action plan for tackling air pollution is envisaged to study its impact.
- As of now, noise pollution is not considered to be an issue in the district and is not paid much attention. Except for the silent zones designated by government, no other silent zones have been found to be established in the district.
- ***Surface and Groundwater Management:*** Tehri Garhwal district has ample sources of fresh water, whether this is an extensive river network or high altitude lakes. River pollution is controlled in the district as all major nalas/drains have been tapped. Encroachment has been an issue in the district. Groundwater studies are still on the early stages in the areas that have shown recharge potential.
- River Heval, a tributary of River Ganga is being rejuvenated in the district under the jurisdiction of forest department. A comprehensive plan has been prepared to restore the flow of dying river.
- ***Mining activity:*** Licensed mining activities, primarily sand mining is prevalent in the district. Much of the sites have been authorised by UKPCB. Some cases of illegal mining have been registered for which penalties have been imposed by the geology and mining department.

The execution of this management plan for Tehri Garhwal district will require the integration and co-operation among the stakeholders, viz., natives, public, private organization, local government, etc. This plan aims at reducing the risk on the human health and different environmental components with a target of achieving sustainable development in the district.

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 plainsrealize 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 andThirupalu, 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

Tehri Garhwal is one of the mountainous districts of Uttarakhand State (Fig. 1). It shares its boundary with four other districts;In the North, it is bounded by the district of Uttarakashi, in the South it is bounded by the district of Pauri Garwal, in the East lies the district of Rudraprayag and in the West lies the district of Dehradun. The headquarters of the district is at New Tehri, which is a modern town developed overlooking the massive Tehri dam. The district is connected with other districts of Kumaon region, Garhwal region and the National Capitalwith a series of National and State highways (NH 58, NH 119, NH 94, SH 8).

Tehri Garhwal got its name from the presence of a number of forts built by the Panwar dynasty rulers. The area was ruled for almost 915 years (888 to 1803) by prince Kanakpal and its descendants. The area was invaded by Gurkhas in the starting of 19^{th} century. However, with the help of East India company, ruler Sudershan Shah got his kingdom liberated from the clutches of Gorkha rulers. Afterwards, the East India company merged Kumaon, Dehradun Dun and East Garhwal in the British empire and the west region was given to Sudershan Shah which then came to be known as Tehri Riyasat. Series of movement by the inhabitants led to the fall of the dynasty and finally its amalgamation with independent India in 1949.Subsequently the Riyasat was merged in Uttar Pradesh.

The district of Tehri Garhwal has also got a lot of religious significance and is regarded as sacred hill district of Uttarakhand state. Muni-ki-Reti and Tapovan are well known places of penance for saints from time immemorial. Devprayag, one of the Panch Prayag in located in the district. It is the place where Bhagirathi and Alaknanda river meets and merges to form The Holy Ganga river. Tehri Dam, a multi-purpose rock and earth fill embankment dam on river Bhagirathi is also located in Tehri Garhwal district. It is the tallest dam in the India standing at a height of 260.5 metres.

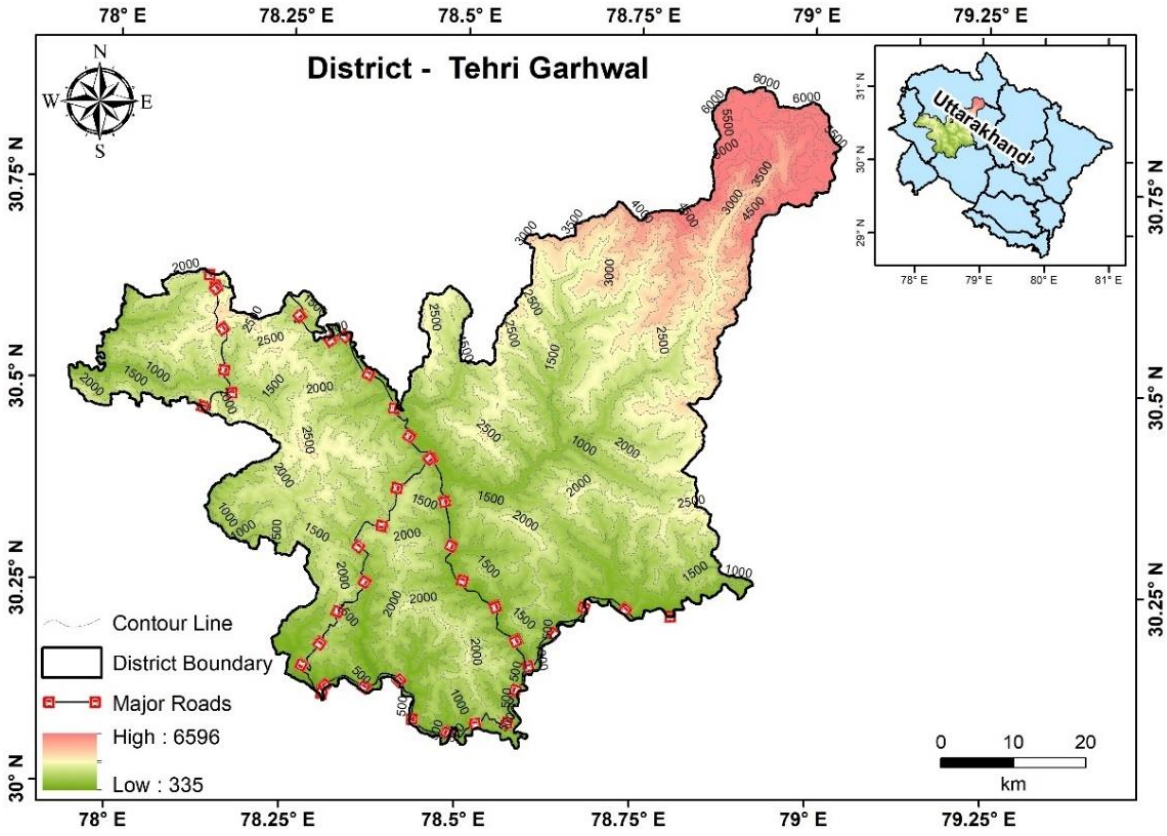


Fig. 1. Location map with major roads and elevation changes in Tehri Garhwal district

District at a glance

Table 1 represents the geographical aspect,population data and administrative setup of Tehri Garhwal district

Table 1. District at a glance

Geographical Location	
Latitude	30°12'N – 30°37'N
Longitude	78°08'E – 78°52'E
Geographical Area	3642 km^2
Elevation of district headquarter	1750 m
Population Data	
Total Population	618931

Male Population	297986
Female Population	320,945
Population density	170
Decadal Population growth rate (2001-2011)	2.35%
Overall Literacy rate	76.36%
Male literacy	89.76%
Female literacy	64.28%
Sex Ratio	1077
Urban Population	11.33%
Rural Population	88.67%
Adminstrative Divisions	
Tehsils	12
Sub-tehsils	02
Blocks	09
Nyay Panchayats	75
Village Panchayats	1035
Total census villages	1758
Municipal councils	05
Nagar panchayats	05
Cantonment boards	---

Source: District Census Handbook 2011 and District Survey Report 2016

Topography

Geographically, Tehri Garhwal district may be divided into two major units-low to high denudational mountains and the river valleys. The northern part has steep slope while southern part has a comparatively gentle slope and deeply dissected valleys. This district lies within an elevation of 300 to 7000 m and abodes some of the major peaks of the state (Table 2). Drainage area of the district is mainly controlled by perennial rivers such as Bhagirathi, Bhilangana, Alaknanda etc. and their tributaries (Table 3).

Table 2. Altitudinal Zones in Tehri Garhwal district

Ranges	Major Peaks	Elevation (m)
Gangotri Mountain Range	Thalay Sagar	6904
	Jaonli	6632
	Bhartekunta	6578
	Jogin I	6465
	Kirti Stambh	6270
	Jogin III	6116

Source: District profile by District Administration, Tehri Garhwal)

Table 3. Major River Systems in Tehri Garhwal district

River System	Origin	Tributaries
The Bhagirathi River System	Gangotri-Gaumukh, Gangotri Glacier, Uttarkashi	Kedar Ganga, Jadh Ganga, Kakora Gad, jalandhari Gad, Asi Ganga, Bhilangana River etc.
The Yamuna River system	Yamunotri Glacier, Near Bunderpoonch peak, Uttarkashi	Rishi Ganga Kunta, Hanuman ganga, Tons, Giri, Chambal, The Sind, The Betwa etc.
The Alaknanda River System	Alkapuri Glacier, near Badrinath, Chamoli	Mandakini, Nandakini, Dhauliganga, Pindar, Bhagirathi etc.
The Ganga River system	Gaumukh, Gangotri Glacier, Uttarkashi	Yamuna, Tons, Ramganga, Gomati, Ghaghara, Gandak, Ghugri, Kosi, Son etc.
The Bhilangana River System	Khatling Glacier, Tehri Garhwal	Bal Ganga

Source: District profile by District Administration, Tehri Garhwal)

Climate

The climate in Tehri Garhwal district varies from cold temperate, tropical to sub-tropical. The northern and north western parts of the district experiences sub-zero temperature (during the winter) whereas the central and southern parts are comparatively warm and humid. Snowfall is quite common during the winter in high altitude regions. Temperature becomes highest usually during June with mean minimum and mean maximum temperatures of 32.6°C and 36.5°C respectively.

Rainfall

Tehri Garhwal district receives rainfall throughout the year. Rainfall predominantly occurs in the monsoon season pertaining to the fact that the 70% to 80% of the annual rainfall happens during the months of July to September. August is usually the wettest and rainiest month accounting for about 75% of the annual rainfall. During the non-monsoon season, rainfall is usualy low (November) but increases from December onward till March. Winter precipitation is associated with the passage of the Western disturbances and Frontal cyclones along the Polar front is in the form of snowfall on higher elevations.Rainfall is measured in weather observatories at different locations of the district(Table 4).

Table 4. Annual Average Rainfall at weather observatory of Tehri Garhwal district

Weather Observatory	Average Annual Rainfall (mm)
Tehri Garhwal	1028.6
Narendranagar	956 to 2449
Mukhim	1708.8

Groundwater

This district is majorly covered by Himalayan Mountain ranges. In the northern part of the district, which is covered with snow almost throughout the year, the possibility of ground water development for irrigation, drinking and other purposes is very less. Taking into consideration the extremely rugged topography in major parts of the district, it is not feasible to go for a large-scale ground water development (Groundwater brochure of Tehri Garhwal district, 2011).

Flora and Fauna

Flora

The flora of Tehri Garhwal district includes the vast range of speicies found in the Himalayas.Chir (*Pinus roxburghii* Sarg.), Oaks (*Quercus leucotrichophora*A.Camus), Deodar (*Cedrus deodara*Roxb. ex D.Don), and Burans (*Rhododendron arboreum* Sm.)etc.are the major species found in the district. Various types of fruit trees like the figs (*Ficus carica* L.), Kaiphal (*Myrica esculenta*Buch.-Ham. ex D.Don), mulberry (*Morus alba* L.), apricots (*Prunus armeniaca* L.), plums (*P. domestica* L.), peaches (*P. persica*L.Batsch)are also prevalent in the district besides a variety of herbal plants bushes, scrubs and grass.

Forest: Forests are mainly found in the upper ridges and around the valleys of the district. About 56% of the total area of the district is covered with forests (Table 5) which plays a significant role in economic, industrial and environmental point of view in the district (FSI, 2019).

Table 5. Distribution of forest cover of Tehri Garhwal district.

District	Geographical Area	Very Dense Forest	Mod. Dense Forest	Open Forest	Changes as of 2017-2019 assessment
Tehri Garhwal (Km^2)	3642	272.71	1084.08	709.19	0.98

Source: *Forest Survey of India, India state of forest report (2019), Volume 2*

Fauna

The district has been the habitat of a large variety of mammals, birds, reptiles and fish. It is noted for the black bears which are found in the Tehri forest division at lower altitudes and the brown and white bears which are found at higher altitudes. The prominent bird's species found in this region are pheasants(*Phasianus colchicus*), partridges (*Perdix*), pigeonsand dovesharials (*Columbidae*), parrots (*Psittaciformes*), chatak (*Clamator jacobinus*), papiha (*Hierococcyx varius*), nilkanth (*Coracias benghalensis*), etc.

Culture and Tradition

Plethora of temples, spiritual tourism and splendid beauty of Himalayan rivers and valleys are the major attraction of this district. The 'Budha Kedar', 'Surkhanda Devi', 'Chandrabadni Mata' 'Nachiketa Taal' 'Koteshwar Mahadev' temples have immense significance in the region. From Ghagra dresses of women to the delicious Phaanu dish and from Langvir Nritya to the Jhodas folk songs, everything binds the people here. The beliefs and lifestyles of Garhwali people dominate the culture. Apart from the Garhwali people, the district is home to Jaunsari, Buksha, Tharu, Bhotia and Raji ethnic groups.

ENVIRONMENT CONCERNS IN THE DISTRICT

The Garhwal region as a whole has been on a grip of severe famines, earthquakes and other natural calamities since 19th century. Environmental hazards such as torrential rains, cloud burst, flash flood etc. continues to persist in this ecologically fragile region. There are many incidences where the large areas were devastated due to cloudburst-triggered debris flow and flash floods (Sati 2007). This has led to exaggeration of other issues such as lack of drinking water, health facilities, weak agricultural output and poor socio-economic conditions. The rural areas of the district have to bear the brunt of these reoccurring hazards. Pheti kimoda village of Jaunpur was one of the top ranking sites featured in the vulnerability risk assessment of the climate change wing of forest department.

The construction activities such as road, hydropower and mining further accentuate the fragility and instability of landscape. Rampant construction activities have added to the scarcity of drinking water in some villages. Moreover, illegal construction activities for commercial as well as domestic purpose on the river banks, flood plains have posed a threat to riverine ecology as well as wildlife.

In Garhwal region, the hydropower projects, which have been constructed or are under construction, are located in the densely populated river valleys. The Bhagirathi River is fragmented due to the existing commissioned hydropower projects such as the Tehri Dam which at places have rendered the mighty glacial-fed river as a mere seasonal stream. According to the Ravi Chopra Committee report (2014), out of 217 km stretch of the river, around 70% (average) is fragmented due to the obstruction caused by ambitious hydropower projects.

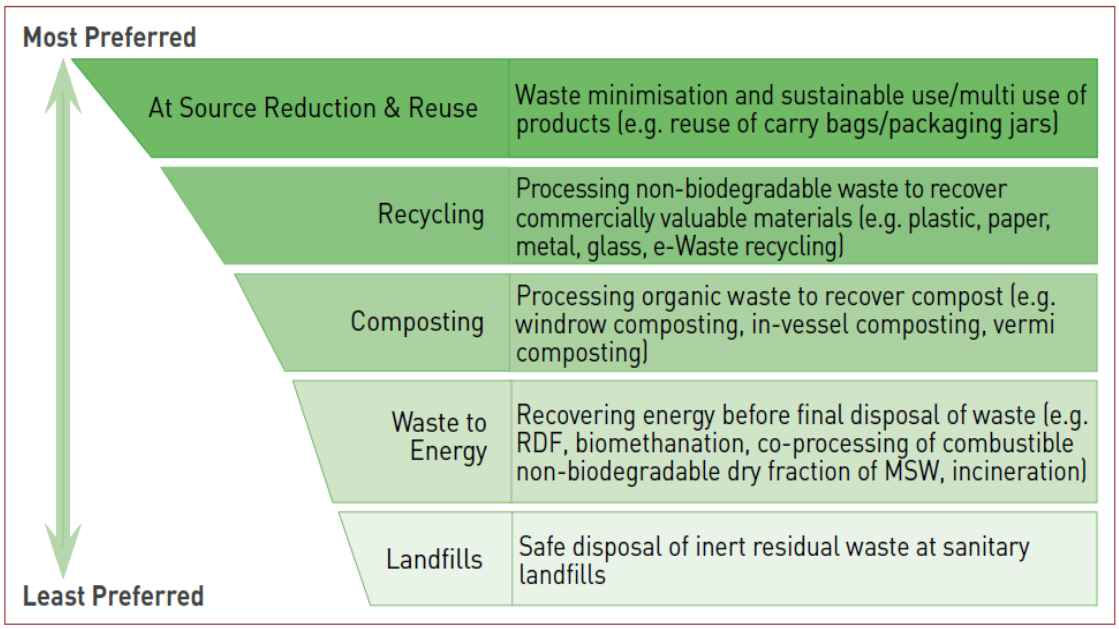
IMPACT AND DATA ANALYSIS

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 of while maximizing resource recovery and efficiency (Fig. 2). 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: MoHUA, 2016)

Fig. 2. Waste management paradigm

Current status in the urban areas of the district

Overall waste generation is substantial in NPP Muni-ki-Reti and NPP Tehri compared to that of NPP Devprayag (Table 6). Primary waste management operations including source segregation and door to door collection are robust in the district. Management of dry waste is done in both manual and automated manner (Table7).

Table 6. Inventory of total solid waste generation

Name of Urban Local Body (ULB)	Population (2011 census)	Number of wards	Solid waste generation (MTPD)			
			Dry	Wet	*Other Waste	Total
Nagar Palika Parishad(NPP)Muni Ki Reti	28636	11	05	08	Not Estimated	13
Nagar Palika Parishad (NPP) Tehri	24014	11	2.5	4.6	2.5	9.60
Nagar Palika Parishad (NPP) Chamba	10457	09	2.5	1.2	0.3	4.0
Nagar Palika Parishad (NPP) Narendranagar	6049	07	0.4	0.8	Not Estimated	1.2
Nagar Palika Parishad (NPP) Devprayag	2868	04	1.0	0.29	Not Estimated	1.29
Nagar Panchayat (NP) Chamiyala	5017	07	0.5	1.5	Not Estimated	2.0
Nagar Panchayat (NP) Ghansali	3154	07	0.6	1.25	0.15	2.0
Nagar Panchayat (NP) Kirtinagar	2517	04	0.4	0.6	Not Estimated	1.0
Nagar Panchayat (NP) Gaja	2098	04	0.55	0.40	0.05	1.0
Nagar Panchayat (NP) Lambgaon	1061	04	0.324	0.216	Not Estimated	0.54

(Source: District administration, Tehri Garhwal, 2021)

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

Table 7. Waste management operations

Waste Management Operations	Outcome	
	ULB	***Source segregation (%)***
Segregation at source	NPP Muni Ki Reti	90
	NPP Tehri	80
	NPP Chamba	90
	NPP Narendranagar	100
	NPP Devprayag	90
	NP Chamiyala	100
	NP Ghansali	100
	NP Kirtinagar	75
	NP Gaja	100
	NP Lambgaon	100
Door to Door Collection	All the ULBs have 100 percent coverage for door to door collection.	

<table>
<tr><td>Sweeping</td><td colspan="2">All ULBs in the district are accomplishing 100% sweeping manually (NPP Tehri is performing mechanical sweeping in some areas).</td></tr>
<tr><td rowspan="12">Segregated transport of waste (received from door to door collection)</td><td>ULB</td><td>Transportation of waste in segregated manner (%)</td></tr>
<tr><td>NPP Muni Ki Reti</td><td>90</td></tr>
<tr><td>NPP Tehri</td><td>80</td></tr>
<tr><td>NPP Chamba</td><td>90</td></tr>
<tr><td>NPP Narendranagar</td><td>100</td></tr>
<tr><td>NPP Devprayag</td><td>90</td></tr>
<tr><td>NP Chamiyala</td><td>100</td></tr>
<tr><td>NP Ghansali</td><td>100</td></tr>
<tr><td>NP Kirtinagar</td><td>75</td></tr>
<tr><td>NP Gaja</td><td>100</td></tr>
<tr><td>NP Lambgaon</td><td>100</td></tr>
<tr><td colspan="2">Collected segregated waste is transported by twin compartment vehicles andrest (i.e. unsegregated waste) is transported in combined manner.</td></tr>
<tr><td rowspan="4">Material Recovery Facility (MRF) operation</td><td>ULB</td><td>Type of recovery operation</td></tr>
<tr><td>NPP Muni Ki Reti</td><td>Automated operation</td></tr>
<tr><td>NPP Narendranagar</td><td>Semi-automated</td></tr>
<tr><td colspan="2">Remaining 08 ULBs are performing manual waste management operations.</td></tr>
<tr><td>Involvement of Non-Governmental Organizations(NGOs)/ private agencies</td><td colspan="2">All the ULBs have established linkage with private agencies for waste management operations.</td></tr>
<tr><td rowspan="11">Authorization and issuance of Identity cards to waste pickers/sanitation workers</td><td>ULB</td><td>Number</td></tr>
<tr><td>NPP Muni Ki Reti</td><td>84</td></tr>
<tr><td>NPP Tehri</td><td>65</td></tr>
<tr><td>NPP Chamba</td><td>39</td></tr>
<tr><td>NPP Narendranagar</td><td>27</td></tr>
<tr><td>NPP Devprayag</td><td>25</td></tr>
<tr><td>NP Chamiyala</td><td>20</td></tr>
<tr><td>NP Ghansali</td><td>27</td></tr>
<tr><td>NP Kirtinagar</td><td>13</td></tr>
<tr><td>NP Gaja</td><td>11</td></tr>
<tr><td>NP Lambgaon</td><td>05</td></tr>
<tr><td>Direct linkage with Treatment Storage and Disposal Facilities (TSDF)/ Bio-Medical Waste Treatment Facility (CBMWTF)</td><td colspan="2">Not initiated</td></tr>
</table>

Availability of infrastructure for waste management

Most of the ULBs have outsourced their waste management operations to private agencies. Ample transportation vehicles are available with ULB including trolleys, twin compartment vehicles etc. (Table 8). Wet waste is processed in both centralised and decentralised manner. Only two ULBs perform scientific dry waste management (through Material recovery facility) while most of them prefer manual segregation in trenching ground or dumping site (Table 9).

Table 8. 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 (Dumping Ground/Trenching Ground/Sanitary Landfill)**	**Remarks**
NPP Muni Ki Reti	35	04	21	Available	Dumping site is more of a storage site where waste quantity remains minimal.	Both wet waste and dry waste are being managed in a small dumping ground near MRF.
NPP Tehri	40	14	19	Not Available	Dumping Ground	• Twin compartment vehicles are being used for transportation of segregated waste. • Wet Waste Composting is carried out in both centralised and decentralised manner.
NPP Chamba	12	06	05	Not Available	Trenching Ground	• Twin compartment vehicles are being used for transportation of segregated waste. • Wet Waste Composting is carried out in both centralised and decentralised manner.
NPP Narendranagar	25	02	08	Available	Trenching ground (leftover waste quantity is minimal)	Waste collection is carried out using backpacks where terrain is not suitable for handcart and trolleys.

NPP Devprayag	12	08	14	Not Available	Dumping Ground	Pick-up vehicles (both twin compartment and single compartment) and E-rickshaws are used for collection and transportation of waste.
NP Chamiyala	20	02	08	Not Available	Dumping Ground	• Twin compartment vehicle are being used for the transportation of segregated waste. • Both centralised and decentralised composting are part of waste management operations.
NP Ghansali	13	02	01	Not Available	Trenching ground	• Waste collection is being carried out using hand cartsand backpacks. • Twin compartment vehicle is used for transportation of waste. • Wet waste is being composted in centralised manner.
NP Kirtinagar	20	02	20	Not available	Trenching ground	• Waste collection is being carried out using hand carts, backpacks etc. • Twin compartment vehiclesare used for transportation of waste. • Wet waste is being composted in both centralised and decentralised manner.
NP Gaja	03	02	02	Not Available	• Dumping Ground • Trenching ground us newly constructed.	• Trenching ground is constructed near the dumping site.
NP Lambgaon	07	02	02	Not available	Dumping Ground	• 0.1 ha land is approved for Trenching ground. • Transportation of waste is being carried out using twin compartment vehicle.

Table 9. Methods of treatment, disposal and recovery

Name of ULB	**Wet waste management** ***(Centralised/ decentralized or on-site composting)***	**Dry Waste Management** ***(waste to Energy/ Recycling/ incineration/ open Dumping in Trenching ground/ sanitary landfill)***	**Remediation of the old dump site**
NPP Muni Ki Reti	Apart from 20 centralised composting facilities, windrow composting is also incorporated in wet waste management.	After secondary segregation, the reusable waste is channelized through GBB Technocrate Pvt. Ltd.	Dry waste processing is optimum and leftover waste is minimal. Hence remediation seems redundant.
NPP Tehri	• 19 composting facilities are available in NPP Tehri. Out of which, 15 are decentralized facilities available at different locations of the town including parks, wedding halls, government residential areas etc. • Remaining four composting facilities are available at the final disposal site or dumping site.	• After secondary segregation, the reusable waste is sold to local rag pickers through 'Zero Waste Incorporation'. • Leftover waste is openly dumped at dumping zone.	• Old dump sites are being remediated through phytoremediation. • Historical waste sites are being cleared by sanitation workers. • This waste laden soil is further used for filling the low lying areas.
NPP Chamba	Out of total five composting facilities, two are decentralised pits constructed at government colonies and remaining three centralised pits are operational near the trenching ground.	• Recyclable waste is sold to the recyclers. • The leftover waste is dumped in the trenching ground.	No old dumpsites are available within the ULB.
NPP Narendranagar	• Wet waste is managed in a centralised manner in 08 composting facilities near to trenching ground or final disposal site. • Apart from this, windrow composting is also a part of wet waste management in NPP Narendranagar.	• After categorisation of dry waste, it is being sold to the local rag pickers. • Leftover waste is dumped in the trenching ground.	No old dumpsites are available within the ULB.
NPP Devprayag	Presently, there are total 14 decentralised composting units available in 04 wards of the ULB.	• After categorisation of dry waste, it is being sold to the local rag pickers. • Leftover waste is openly dumped at dumping ground	No old dumpsites are available within the ULB.
NP Chamiyala	Out of 09 composting facilities,08 are in the form of decentralised pits available in different wards of the town. One facility is available at dumping site.	• ULB is selling the non-biodegradable waste to the local rag pickers. • Rest of the waste disposed in the dumping ground.	No old dumpsites are present within the ULB.

NP Ghansali	• 01 centralised composting pit (16 m^3 capacity) is available near to trenching ground for wet waste management. It is also covered by net to avoid the monkey menace. • They have also proposed to construct 03 decentralised pits within the ULB.	• Dry waste is segregated manually at segregation shed, thereafter it is sold to local rag pickers. • Leftover waste is dumped in the trenching ground.	No old dumpsites are available within the ULB.
NP Kirtinagar	• There are 20 composting facilities available in the ULB. Out of these, 12 centralised composting units are available in the trenching ground and 08 decentralised composting units are available at different locations in town including Govt. colonies, Schools etc.	• After secondary segregation and compaction, the dry waste is sold to local rag pickers. • Leftover waste is dumped in the trenching ground.	No old dumpsites are available within the ULB
NP Gaja	Wet waste is processed in 02 composting pits available in the disposal site. Manure is then sold to local people free of cost.	• After categorisation of dry waste, it is being sold to the local rag pickers. • Waste disposal is being shifted from open dumping site to trenching ground.	Dumping ground is undergoing rehabilitation through phytoremediation.
NP Lambgaon	Wet waste is processed at two composting pits constructed in ward no.3.	• After categorisation of dry waste, it is being sold to the local rag pickers. • Leftover waste is disposed in dumping ground. • Establishment of trenching ground is in progress.	No old dumpsites are available within the ULB.

Gap Identification and proposed policies in the district

Apart from primary segregation of waste, there have been some limitations in management of dry waste in Tehri Garhwal district. More than two third of the ULBs in the district are not able to recover and dipose waste in a scientific way (Table 10). However, all ULBs have made budgetary allocations for revamping their waste management operations (Table 11).

Table 10. Gap identification

Name of ULB	Observed shortcomings	Remarks
NPP Tehri	Partial source segregation of waste	ULB has achieved 80% source segregation.
	Non-availability of any waste recovery facility	Currently, dry waste is segregated manually by the sanitation workers.
	No linkage with authorised waste recyclers	Reusable dry waste is sold to local rag pickers with due intervention from the ULB and waste management firm.

NPP Chamba	Non-availability of any waste recovery facility	DPR has been approved for buying vehicles and setting up a recovery facility along with other equipment's for the scientific dry waste management.
NPP Narendranagar	No linkage with authorised waste recyclers	At present, the ULB is selling the reusable dry waste to the local rag pickers.
	Lack of machinery in material recovery facility	Waste recovery operations are carried out in a semi-automated manner.
NPP Devprayag	No linkage with authorised waste recyclers	Composition of dry waste is substantial in total solid waste generated. Although,some percentage of the dry waste is sold to local rag pickers.
	Non-availability of any waste recovery facility	DPR has been approved for improving waste management operations in the ULB.
NP Chamiyala	Non-availability of any waste recovery facility	DPR has been approved for improving waste management operations in the ULB.
	No linkage with authorised waste recyclers	Reusable dry waste is sold to local rag pickers with due intervention from the ULB and waste management firm
NP Ghansali	Non-availability of any waste recovery facility	DPR has been approved for improving waste management operations in the ULB.
	No linkage with authorised waste recyclers	ULB sells their reusable waste to local rag pickers.
NP Kirtinagar	Partial source segregation of waste	ULB has achieved 75% segregation at source.
	Non-availability of any waste recovery facility	• Only compaction of waste is performed near trenching ground. • DPR has been approved for improving waste management operations in Kirtinagar.
	No linkage with authorised waste recyclers	ULB sells their waste to local Rag pickers which is currently a part of informal economy.
NP Gaja	Non-availability of any waste recovery facility	Manual waste recovery method are deployed for waste recovery.
	No linkage with authorised waste recyclers	At present, the ULB is selling their segregated waste to the local rag pickers.
NP Lambgaon	Non-availability of any waste recovery facility	• Dry waste is segregated manually by sanitary workers. • DPR has been approved for improving waste management operations in the ULB.
	No linkage with authorised waste recyclers	Reusable dry waste is being sold to local rag pickers.
**A common gap that has been identified in the waste management operations of the district is the lack of linkage with Treatment Storage and Disposal Facility (TSDF) and Common Biomedical Waste Treatment Facility (CBMWTF) for the disposal of domestic hazardous waste,sanitary waste and biomedical waste.		

Table 11. Proposed policies and budget requirements put forward by different stakeholders in the district

ULB	Proposed Policy	Current status and Budget requirement
NPP Muni Ki Reti	Revamping Solid waste management	• DPR of 3.65 Cr. has been approved by the department for further improvement in solid waste management operations. • NPP Muni-Ki-Reti is declared bin free city in the year 2020.
NPP Tehri	Revamping solid waste management	• DPR of 05 Cr. has been approved by the department to set up various infrastructure required for the scientific disposal of waste in the ULB. • 10 out of 11 wards are declared as bin free wards in the ULB.
NPP Chamba	Revamping Solid waste management	• DPR of 1.45 Cr. has been approved by the department for purchasing waste transportation vehicles and instrumentation for effective solid waste management. • ULB is declared as bin free city in the year 2021.
NPP Narendranagar	Revamping Solid waste management	• The DPR of 1.15 Cr. has been approved by the department for buying machinery for material recovery facility. • ULB is declared as bin free city in the year 2019.
NPP Devprayag	Revamping Solid waste management	DPR of 1.22 Cr. has been approved by the department for solid waste management. Budgetary allocations include development of trenching ground, improving recycling capacity of dry waste and overall scientific management of dry waste.
NP Chamiyala	Revamping Solid waste management	Finances have been approved to improve waste management operations in Chamiyala. This also includes development of trenching ground for disposal of waste.
NP Ghansali	Revamping Solid waste management	• A budgetary allocation of around 1.15 Cr. has been approved for various works including monitoring, IEC campaigns etc. • ULB is declared as bin free city in the year 2018.
NP Kirtinagar	Revamping Solid waste management	• The DPR of 1.83 Cr. has been approved by the department for effective transportation and disposal of solid waste. • Under this DPR, NP Kirtinagar has proposed to setup various infrastructure including waste collection vehicles, material recovery facility etc. • ULB is declared as bin free city in the year of 2020.
NP Gaja	Revamping Solid waste management	The DPR of 85 lakhs has been approved by the department for Waste Management in Gaja.This also includes capacity building campaigns regarding solid waste.
NP Lambgaon	Revamping Solid waste management	DPR of rupees 92.46 lakhs has been approved to procure various types of machinery such as compactor, waste collection vehicles etc.

Rural Solid Waste Management

The domestic waste generated in rural households of India is increasingly becoming an issue of serious concern. As reported bythe Ministry of Drinking Water and Sanitation(MDWS)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 improving 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 the generation rate 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 live 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 contains only domestic waste (92.4%) as a major contributor to the total waste generation.
- Rural community produces comparatively more biodegradable waste (63.5%) compared to non-biodegradable waste (36%).
- About 78% of the rural population use open dumping as storage and collection of solid waste.

Success Stories : NPP Munni ki Reti and NPP Gaza

- NPP Muni-Ke-Reti has obtained1st position in Uttarakhand for past four years and 11th position in the country under the category of 'Garbage Free City Star Rating' under 'Swachh Survekshan 2021'.
- Moreover , it has secured 2nd place amongst the Nagar Panchayats of Uttarakhand under "Atal Nirmal Nagar Puraskar Yojana" in 2019-20. The ULB was awarded an amount of 15 lakh rupees out of which 50 % will be used for the provision of Sanitation workers and rest amount will be used for other waste management operations.
- Nagar Panchayat Gaja was also felicitated under "Atal Nirmal Nagar Puraskar Yojana" in 2019-20 and secured 2nd position amongst all the Nagar Panchayats of Uttarakhand. It was awarded an amount of 07 lakh rupees.

Fig. 3. Waste Management operations in Nagar Panchayat Gaja

Projected Population and Waste generation in Tehri Garhwal District

Projecting waste quantities in a near future is as difficult as predicting changes in waste composition for a locality or town. Storage methods, salvaging activities, exposure to the weather, handling methods and decomposition, all have their effects on changes in waste bulk density. Generally, lower is the level of economic development, greater will be the change between waste generation and disposal.

In the present context, population census data for the year 2001 and 2011 is taken for population forecast.Decadal population and subsequent waste generation projectionis done based on following presumptions:

- Arithmetic increase method is used for the decadal population forecast, hence the rate of change of population with time is assumed constant
- In view of changing waste paradigm and floating population, 1.5% yearly growth in per capita waste generation is assumed.
- Analysis includes population and waste generation estimations for only urban local bodies and does not include peri-urban and rural areas (Table 12 and 13; Fig.4and5).

Table 12. Estimated Population and Waste Generation

ULB	Projected Population			Projected Waste Generation (MTPD)		
	2021	2031	2041	2021	2031	2041
NPP Muni Ki Reti	37948	47260	56572	13.00	18.62	25.63
NPP Tehri	22605	21196	19787	9.60	10.35	11.11
NPP Chamba	8962	10153	11344	4.00	5.21	6.70
NPP Narendranagar	6794	7539	8284	1.20	1.53	1.94
NPP Devprayag	2129	2106	2083	1.29	1.47	1.67

NP Ghansali	3855	4556	5257	2.00	2.72	3.61
NP Kirtinagar	1994	2471	2948	1.00	1.43	1.96
			Total Waste	***33.09***	***41.33***	***52.62***

Table 13. Growth rate of Solid Waste generation

Name of ULB	**Rate of growth % (2021-2031)**	**Rate of growth % (2031-2041)**
NPP Muni Ki Reti	4.32	3.77
NPP Tehri	0.78	0.74
NPP Chamba	3.03	2.85
NPP Narendranagar	2.76	2.64
NPP Devprayag	1.38	1.37
NP Ghansali	3.59	3.27
NP Kirtinagar	4.25	3.72

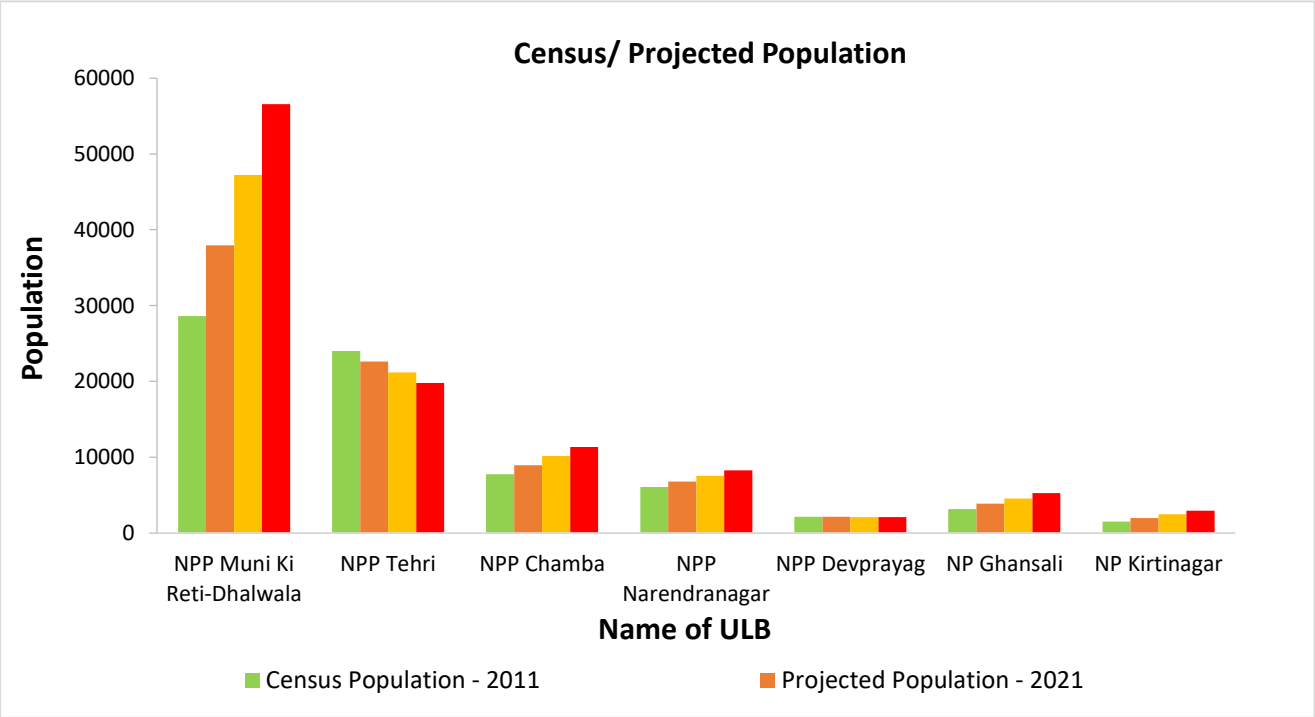


Fig. 4. Graphical representation of projected population in Tehri Garhwal district

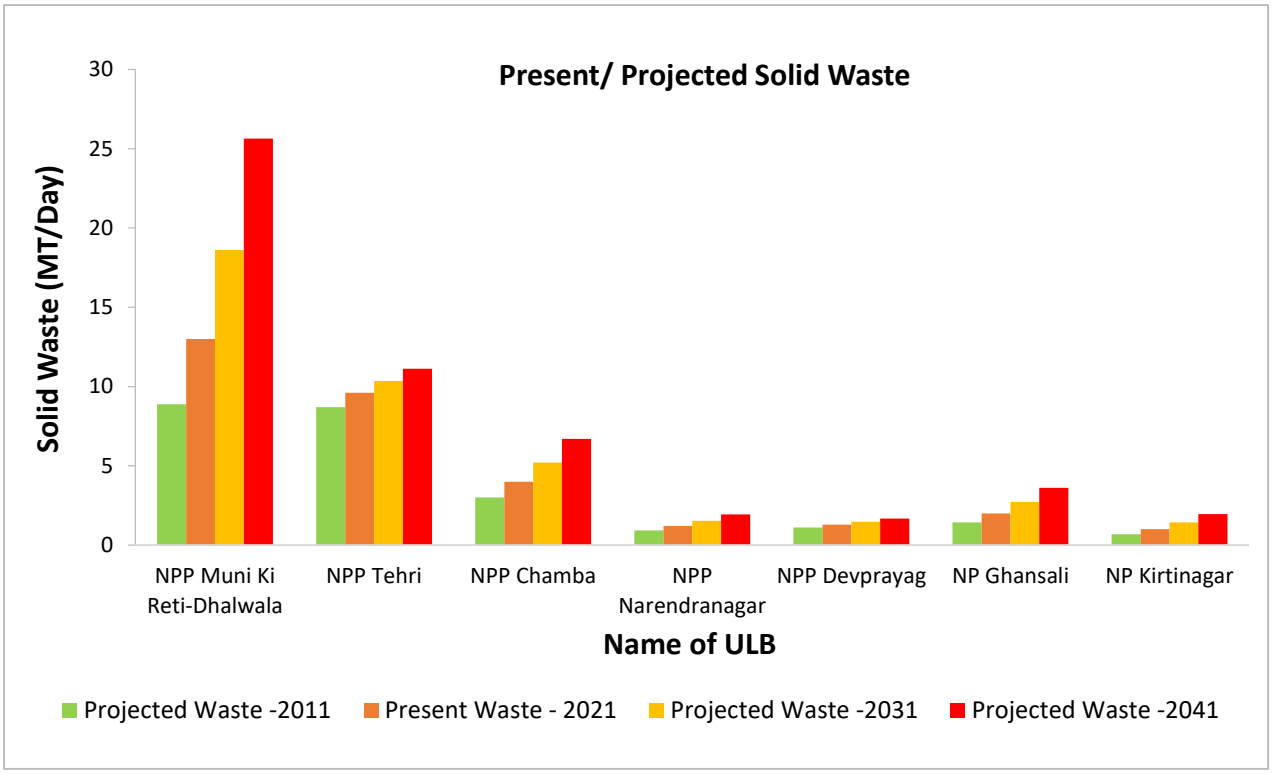


Fig. 5. Projected solid waste generation in Tehri Garhwal district

Inferences drawn after projecting the population and waste generated

- Total waste generation is expected to surpass 50MT by 2040 with maximum growth in NPP Munni Ki Reti.
- To the surprise, NPP Tehri and Devprayag has shown negative population growth rate. Abrupt migration might be one of the reason for this unsual trend.
- With increasing urbanization, the physical characteristics of waste will also change. The quantity of wet waste may decease.However there would be increase in E-waste, Hazardous waste generation.

BIOMEDICAL 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 Healthcare Centres (CHCs), and Primary Healthcare Centres (PHCs). Biomedical waste generation has shown a wide variation in Uttarakhand 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.6).

(Source: CPCB 2019

Fig. 6. Segregationof biomedical waste as per BMW rules, 2016

Importance of Biomedical waste management in the wake of pandemic

Due to the onset of covid pandemic, biomedical waste generation increased worldwide. Similar trend was also observed in our country from 2019 to 2021. The daily biomedical waste generation increased from 619 MTPD to 800 MTPD in India (CPCB, 2021)and from 3.8 MTPD to 6.26 MTPD in Uttarakhand state (ENVIS, 2020).

At present, the biomedical waste is being generated not only from the health care facilities but also from the quarantine centres, and residential areas where patients were in a home isolation. Bio-medical waste ought to be segregated in the households as well as from the municipal solid waste. Thus, it has to be properly disposed of to get rid of the risks of infection among the workers handling the municipal solid waste in urban local bodies.

Biomedical waste management in Tehri Garhwal district

Further many of the healthcare facilities are not authorised by the State Pollution Control Board(SPCB)/ Pollution Control Committee (PCC) their authorised certificates were expired. Healthcare facilities in the district are also lagging in the barcode tracking of biomedical waste as per the Biomedical Waste Management Rules 2016 (Table 15).

Table 14. 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	101
		Non-bedded HCFs	337
		Veterinary Hospitals	40
		Pathology Labs	03
		Dental Clinics	07
		Blood Banks	--
		Animal Houses	--
		Bio-Research labs	--
		Others	--
		Total	388
3.	Number of health care facilities authorised by SPCB/PCC	101Bedded &337 Non-bedded health care facilities of the district areauthorised bythe state pollution control board (SPCB).	
4.	Linkage with Common Bio-medical Waste Treatment Facility (CBMWTF)	Healthcare facilities of the district have partially linkage with the CBMWTF (Roorkee).	
5.	Total Biomedical Waste (BMW) generation in the district	46.87 kg/day	
6.	Daily Bio-Medical Waste (BMW) lifting by Common Bio-Medical Waste Treatment Facility (CBMWTF)	12.15 kg/day	

Table 15. Current status of biomedical waste management

S. No.	Action areas	Outcomes
1.	Adequacy of facilities to treat biomedical waste	• At present no facility is available in the district, solely for the treatment of biomedical waste. • Deep Burial method is preferred for disposal of biomedical waste by HCFs(except for the waste that is lifted by CBMWTF).
2.	Segregation of BMW as per guidelines of BMW Rules, 2016	All the healthcare facilities of the district properly segregate their biomedical waste into separate colour-coded bins as per BMW Rules, 2016.
3.	Tracking of biomedical waste(Implementation of bar code system for tracking)	Not Inititated
4.	District level monitoring committee	Already established under the chairmanship of the District Magistrate.

Gap identification in the management of biomedical waste in the district

As far as the management of the biomedical waste is concerned the district is lacking in many aspects. We compared the current status with the desired level as per biomedical waste management rules, 2016 and found following gaps:

- Some HCFs haven't got the authorisation from State Pollution Control Board as per rules.
- Coverage for Daily lifting of biomedical waste by CBMWTF is less.

CONSTRUCTION & DEMOLITION WASTE MANAGEMENT

Construction and Demolition (C&D) waste is produced in the construction, remodelling, repair and demolition of residential / commercial buildings and other structures and pavements. C&D waste mainly consists of concrete, bricks, sanitary ware, glass, steel, plastic, etc. (Table 17). According to a general estimate, 40% of the total C&D waste originates from renovation work, while 50% from the demolition work and remaining 10% from new construction work (Table 18), (CPCB, 2020).

Implementation of 3Rprinciple in C&D waste management

Construction and demolition waste is inert in nature. It does not create chemical or biochemical pollution. Hence in view of its management, maximum emphasis should be given on 3R Principle.The concept of 3R, which refers to reduce, reuse and recycle particularly in the context of production and consumption is well known today. Waste reduction is presumed to be optimal measure for C&D waste management due to its minimal adverse impact on environment. Applicable building materials can be reused for original activity or to fulfil any other purpose. Steel, doors and windows, wood, bricks and other construction items can be easily taken out and again put to reuse without much processing. The last but not least step is to recycle the C&D waste considered fit for recycling. This is usually done by converting the waste into recycled sand and aggregates that have various construction applications. This principle can be applied to the entire life cycle of products and services – starting from design and extraction of raw materials from collection to transport, and then manufacturing, practicing scientific disposal. Hence, it is evident that application of 3R principle would help reduce the C&D waste in the construction industry.

Present state of affairs

- According to a report by Transparency Market Research (2016), the volume of construction waste generated worldwide every year will nearly double to 2.2 billion tonnes by 2025 (CWM, 2020).
- Our country generates 150 million tonne/year C&D waste but the official recycling capacity is a meagre 6500 tonnes/day or just about 1% *(as per building material promotion council* (CWM, 2020).

Table 16. Characterisation of C&D waste in India

Debris type	Percentage (%)
Wood	42.4
Drywall	27.3
Concrete	12.0
Brick and Other Mixed Debris	7.3
Cardboard	5.4
Metals	1.8
Asphalt	1.4
Plastic & Foam	1.4
Other packaging	0.6
Textiles	0.4

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

Present infrastructure within the state

- Currently, no treatment facility is available in the state for processing the C&D waste.
- In the hilly districts, ample dumping zones are not established due to which waste is dumped at the riverbanks.
- 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.

C&D waste management in the district

Construction and demolition waste is not yet quantified in the district pertaining to the fact that its quantity is assumed to be minimal (Table18). However, C&D waste generated is used locally for reparation and renovation purpose under the jurisdiction of the concerned department.

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

S. No.	Action Areas	Outcomes/Remarks
1.	Quantity of C&D waste generated (kg/day)	Not yet quantified in the district(It is assumed to be minimal).
2.	Collection of C&D waste	Waste collection has been inititated by few ULBs. After

		collection,it is used locally for filling low lying areasand repairing of roads.
3.	Establishment of deposition points/ dumping zones	Not initiated
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 hasdirect linkage with any common C&D waste treatment facility.

Gap Identification

Basic amenities required for C&D waste management such as collection,transportation and deposition points are missing in almost all the ULBs of Tehri Garhwal district.Moreover the administrative guidelines including byelaws for C&D waste management are not yet formulated.

C&D waste managementin rural areas

In the rural areas of the district, construction work is very limited thereforeminimal 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 because 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

- Almost 9 MMT of hazardous waste was generated in India in the year 2020. Half of the hazardous waste generated was utilizable (Table 20).
- Hazardous and Other wastes (Management and Transboundary Movement) rules, 2016 govern the collection, transfer, Processing, treatment and disposal of hazardous waste.
- The rules were amended on March 2019 keeping in consideration the ease of doing business, boosting make in India initiative by simplifying the procedures, while at the same time upholding the principles of sustainable development.
- According to CPCB Report 2019-20, there are 69,308 hazardous waste generating units in India having authorized annual capacity to generate about 39.46 million MT of hazardous waste. However, about 8.78 million MT hazardous waste was generatedduring 2019-20, based on the annual returns submitted by such units (CPCB, 2020).

Table 19. Hazardous Waste generation in India

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

Hazardous waste management in the district

Hazardous waste generated in the Industries is quantified on yearly basis in the district(Table 20).More than half of the total amount of hazardous waste is recyclable/reusable. Industries have

linkage with a Treatment,Storage and Disposal facility to channelize their hazardous waste (Table 21).

Table 20. Inventory of hazardous waste in the district

S. No.	Parameter	Present status			
1.	Quantity of Hazardous waste generated in the district (MT/annum)	Incinerable	Landfillable	Recyclable/ Reusable	Total
		1.201	0.861	2.646	4.708
2.	Number of Hazardous waste generating industries in the district	74			

Table 21. Current status related to Hazardous waste management

S. No.	Action Areas	Remarks
1.	No. of captive / common Treatment Storage and Disposal Facilities (TSDF) in the district.	Currently, there is no captive or common 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	Currently, the hazardous waste generating industries of the district have linkage with the following Treatment Storage and Disposal facility (TSDF): 01 (M/s Bharat Oil waste Management) at Roorkee, Haridwar, Uttarakhand.
3.	Display board of hazardous waste generation in front of gates of respective industries	As per State Pollution Control Board only 05hazardous waste generating industries in the district have installed display board in front of their gates.
4.	Number of ULBs directly linked with common TSDFs	No ULBs in the district is directly linked with common TSDFs.
5.	Contaminated sites/probable contaminated sites within the district	As per state pollution control board there are no contaminated sites within the district.
6.	Regulation of industries & facilities generating hazardous waste	Industries generating Hazardous waste are strictly regulated by SPCB.

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). Computer devices contributes to almost two third of electronic waste in India. (Table 23). It is categorised into 21 types under two broad categories:

- Information technology and communication equipment.
- Consumer electrical and electronics.

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 (ASSOCHAM, 2018).

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**.** Amendments were further made on March 2019 with the objective of channelizing the E-waste generated in the country towards dismantlers and recyclers in order to formalise the e-waste recycling sector.

Table 22. Bifurcation of E-waste based on electronic appliances

Types of Waste	**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 Million Metric Tons (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 Million Metric Tons 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

- According to Central Pollution Control Board (CPCB), India generated more than 10 Lakh tonnes of e-waste in 2019-20. Against this, the e-waste dismantling capacity has not been increase from 7.82 lakh tonnes since 2017-18
- In 2018, the Ministry of Environment had told the tribunal that 95% of e-waste in India is recycled by the informal sector and scrap dealers unscientifically dispose of it by burning or dissolving it in acids.
- India has emerged as fifth largest E-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%.
- India's first e-waste clinic for segregating, processing and disposal of waste from household and commercial units has been set-up in Bhopal, Madhya Pradesh

E-waste management in the district

Local citizens are selling their electronic items to the local rag pickers. Also the collection of E-waste is not initiated by any of the ULBs, as the amount is assumed to be very minimal so the it is not possible to quantify the E-waste in the district (Table 23). None of the ULBs has established direct linkage with the authorised e-waste recycler/ dismantler, also no initiation has been taken by any of the ULBs for toll free number facility to deposit their E-waste.

Table 23. Current standpoints regarding e-waste generation and collection

S. No.	Parameter	Outcome & Remarks	
1.	Quantity of E-waste generated per annum *(*As per SPCB)	Uttarakhand (MT)	*16260*
		Tehri Garhwaldistrict	*Not Estimated*
2.	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	
3.	Toll-free number in the district for the	Facility of toll free number to deposit E-waste is not	

	citizens to deposit E-waste.	initiated in the district.
4.	Collection centre established by ULBs in the district.	At present there are no collection centre established by any of the ULBs or the district administration.
5.	Linkage with any E-waste recycling facility	No ULBs have established linkage with authorised E-waste recycling facility, However district administration have linkage with the authorised E-waste recycling facility to deposit E-waste generated from the government office.
6.	Control over illegal trading or processing of E-waste in the district.	Controlled

Gap Identification

E-waste is currently not streamlined in the waste management operations of the distirct. As the quantity is minimal,hence ULB does not feel the need to address the issues related with the management of E-waste.Due to lack of strategy, electronic waste in government institution is not processed and lies idle,consuming spaces in the buildings.

WASTE WATER MANAGEMENT AND SEWAGE TREATMENT PLANT

Domestic sewage is such a waste water that is produced by a community within a certain locality. It is characterized by a certain volume of flow and physical condition, along with chemical and toxic constituents and its bacteriologic properties. Around 80% of water supply flows back into the ecosystem as wastewater which can be a critical to landscape and other environmental components (Denchak, 2018) Also, health hazard could be other issue in case it could not be treated properly.

According to a report of the Central Pollution Control Board (2015), India has the capacity to treat approximately 37% of its wastewater. In other words, this comes about 22,963 million litres per day (MLD), against a daily sewage generation of approximately 61,754 MLD. Moreover, most of the sewage treatment plants do not function at their optimum capacity and do not conform to the standards as prescribed. (Table 24)

Sewerage system with individual household latrines connecting with pipelines comes only 31.7 per cent of the total urban households. More than half of the urban population in the State relies on on-site sanitation (OSS) systems like septic tanks. Septic tanks cover *53.1 per cent* of the total sludge 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 24. Current Scenariorelated to STPs (MLD) 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 scenariorelated to STPs in the district

Sewage treatment infrastructure has been developed in the district under National Mission for Clean Ganga (NMCG). Total 9 STPs are currently operational in Ganga priority towns as envisaged under Namami Gange project(Table 25).All major nalas have been tapped through interception and diversion works.More than 50% of the household in each of these Ganga priority towns are connected with STP.Feasibility of leftover towns is assessed to expand the sewerage

network (Table 26). Budget estimates have been sent to Special Program management group(SPMG) for expansion of sewage network in Tapovan (Table 27).

Table 25. Inventory of Sewage treatment facilities in district

ULB	Location	Installed STP capacity (MLD)	*Operational capacity (MLD)	Status of nalas meeting the waterbodies		
				No. of nalas	No. of tapped nalas	No. of untapped nalas
NPP Muni ki reti	Dhalwala(Chandreshwar Nagar)	7.50	6.50	13	13	00
	Chorpani	5.00	4.20			
	Tapovan	3.50	1.10	07	05	02[b]
NPP New Tehri	Bhagirithipuram	5.00	2.50	---	---	---
NP Devprayag	Shanti bazar	0.075	0.04	04	04	00
	Sangambazar	0.15	0.15			
	Baah Bazar	1.40	0.04			
NP Kritinagar	BRO Bridge	0.05	0.03	03	03	00
	Near Temple (Kritinagar)	0.01	0.01			

**Operational capacity is floating value as the waste water quantity varies seasonally.*

[b] *These two nalas are seasonal and currenty requires no interception or diversion.*

Table 26. Adequacy of Sewerage Network

S. No.	Location	Total household/ hotels viable to be connected	Households/Hotels connected (%)	Remarks
1.	Muni ki Reti	3695	1633 (44.19%)	Out of the remaining 2062 households: • 122 have their own septic tanks. • Preliminary survey is in progress for 220 households. • DPR has been prepared for leftover 1720 households.
2.	*Tapovan	856	625 (73.01%)	A 10.05 km sewer line has been laid for connection with STP.
3.	New Tehri	-	-	70 % of the households are connected through sewerage system.
4.	Devprayag	609	384 (63.05%)	Out of remaining 225 households: • 58 will be connected through sewer connection.(16 of them will be connected by shifting of toilets) • 111 households will be managed through septage management.

**Tapovan comes under the jursiduction of Nagar Palika Muni-ki-Reti*

Table 27. Proposed policies regarding waste water management

Policy	Concerning ULB	Remark
Expansion of Sewerage Network	Muni Ki Reti (Tapovan)	Estimate of 1108.81 lakh ruppes has been proposed for connecting 226 households with STP.

Success Story – Sludge Management Plant at Chorpani, Muni ki Reti

Overview slude management plant at of Muni ki Reti

Sewage Treatmenr Plant (STP) at Chorpani and Chandreshwarnagar are constructed under National Mission for Clean Ganga (NMCG). As per the original contract, the sludge generated from the STPs shall be disposed at site given by municipality within a distance of 10 km from the STP. However due to some anomlaies, the municipality didn't gave clearance to the land. In the absence of sludge disposal area, excess sludge generated in STPs was creating nuisance and was even compromising the STPs performance.

After different stakeholders intervention, it wast decided to explore the option sludge disposal/ sludge volume reduction from these STPs.Subsequently, administrative approval and expenditure sanction was provided for the installation of Sludge Management plant at 5.0 MLD capacity STP at Chorpani (Fig.7).

About Sludge Management Plant

It is a novel sludge volume reduction technology wherein sludge is further stabilized thermally and volume of produced sludge is reduced by 90 %.The output of the plant is inert content which can be utilized in various application including backfilling, thus converting sludge into a resource.Information related to Sludge management plant in Chorpani is provided (Table 28).

Table 28. Outline of Sludge Management Plant in Chorpani,Muni ki Reti

Parameter	Remark
Feed Capacity	5 tons/day
Operation and Maintenance	For the Time Period of 10 years
Estimated amount (including O &M for 10 years)	Rs. 8.67 crores

Fig. 7. Sludge management Plant in Chorpani,Muni ki Reti

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.However,some policies have been promulgated by both central and state government for effective waste water management in rural areas (Table 29).

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 29. 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.

Groundwater management in the district

Tehri district is quite rich in terms of water resources, be it rivers or high altitude lakes (Table 30).Major tributaries of River Alaknanda and Bhagirathi drains the flood plains of the district. Illicit dumping of waste and open defecation have been controlled in the river ban.All the major

nalas are tapped and have been connected to STPs under National Mission for Clean Ganga (NMCG) (Table 31).

Table 30. Water Resources im the district

Water Resource	**Remarks**			
River/Streams	***Name***	***Total Length within the district (in kms)***	***Place of origin***	***Altitude at origin(m)***
	Alaknanda	82.489	Satopanth Glacier	4600
	Bhagirathi	91.21	Gomukh	4255
	Ganga	61.09	Devprayag	470
	Song	38.45	Uniyal Gaon	1896
	Bandal	17.36	Bhangla Sera	1254
	Chandra Bhaga	13.646	Gwar	1133
	Yamuna	26.42	Nain Gaon	876
	Aglar	34.34	Marora	1865
	Hewal	38.61	Saur	1659
	Bhilangna	80.05	Khatling Glacier	3717
	Nailchami Gad	19.30	Tharti	1858
	Jalkur Gad	22.45	Kodar	1477
	Baal Ganga	43.50	Giwali	2157
	DharamGanga	12.60	Pinswad	2217
Lakes and Ponds	***Name***	***Area***	***Elevation (m)***	
	Jaral Tall-1	0.52	2192	
	Jaral Tall-1	0.52	2193	
	Majyaad Tall	0.40	2351	
	Mahasar Taal	0.18	2850	
	Chandriya Taal	0.20	3113	
	Sahastra Taal	2.00	4572	
	Bhaasar Taal-1	0.20	2252	
	Bhaasar Taal-2	0.20	2251	

Table 31. 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	Controlled
4.	Nalas/drains meeting rivers	All the major nalas/drains have already been tapped in recent years under the 'Namami Gange' mission. Currently, No major contaminated drain has a direct outfall in the water bodies in the district.
5.	Disposal of untreated sewage in rivers	Sewage is not directly discharged into water bodies.
6.	Monitoring of action plans for	Monitored

	rejuvenation of rivers	
7.	Encroachment near flood plains	Encroachment is found in almost all the urban settlements along the river valleys.
8.	Protection of flood plains	Robust measures have not been taken so far.

Ground water management in Tehri Garhwal District

As far as ground water is concerned . no such studies have been conducted by concerned departments to assess the present conditions of ground water table in the district.However it has been reporte that groundwater pollution doesn't exist in the district.(Table 32).

Table 32. Information of groundwater in the district

S. No.	Parameter	Current Status
1.	Groundwater polluted area in the district	Not Identified
2.	Adequacy of Groundwater Availability	No studies are conducted so far by the concerning department for the assessment of the groundwater.
4.	Access to surface water and groundwater quality data at DM office	Available

Current standpoint regarding water resources management in Tehri Garhwal district

Present state of affairs

- Common water sources used for water supply schemes over the district are:
  1. *Deep Tubewells*
  2. *Khadins / Nadins/ Tankas/ Ponds / Wells/ Ooranis*
  3. *Rivulets/Naulas/Gadheras*
  4. *Spring*
  5. *Streams*
- Rivulet / Naula / Gadhera (53.4%)followed bySprings (20.1%) andKhadins / Nadins/ Tankas/ Ponds / Wells/ Ooranis (15.6%) are noted to be highly tapped for water schemes in Tehri Garhwal district.
- The Jakhanidhar block has the highest water dependencyon Springs, approximately 45% of total water supply..
- Awareness activities are organized quarterly to bring awareness amongst people about the declining standards of water quality as well as overexploitation of Naulas and Dharas.
- No information is currently available on the annual change of Ground water level in the district

Artificial Recharge of Groundwater

Certain areas of the district shows moderate to good scope for groundwater development. Hydrogeological investigations have been carried out in some areas to access the pertaining ground water conditions in the district (Table 33).

Table 33. Scope of Artificial recharge in Tehri Garhwal district

District	**Area (sq.km)**	**Area identified for AR (Artificial recharge) (sq.km)**	**Volume of unsaturated zone (MCM)**	**Available sub-surface space for AR (MCM)**	**Water required for artificial recharge (MCM)**	**Surplus available for recharge (MCM)**
Tehri Garhwal	3796	949	1898	285	379	2374

Some techiques have been used in the district for groundwater and surface water management including construction of rain water harvesting structures, Chal-Khals etcunder catchment area conservation Program (CACMP). Budgetory estimates have been prepared for additional structures proposed under the scheme.(Table 34 and 35).

Table 34. Artificial Recharge and RTRWH Structure constructed in Tehri Garhwal district

District	Number of structures					Total cost (in lakhs)					Total cost (in lakhs)
	CD	CK	RTRWH	PT	CT	CD	CK	RTRWH	PT	CT	
Tehri Garhwal	76	19	112	04	00	7.6	0.57	39.2	0.08	0	47.45

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

Table 35. Artificial recharge and cost estimate in Tehri Garhwal district

District	**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	
Chamoli	350	250	90	225	450	0.5	0.3	0.07	0.15	0.015	175	75	6.3	33.75	6.75	296.8

CT-Contour Trench, CK- Chal Khal, RTRWH- Rooftop rainwater harvesting, CD- Check Dam, PT- Percolation 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 ofNational 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 $PM_{2.5}$ and PM_{10} concentration by 2024 is proposed under the NCAP taking 2017 as the base year for the comparison of concentration.The ambient air quality standards as set by Central Pollution Control Board are mentioned (Table 36).

Table 36. National ambient air quality standards in India.

Pollutant	**Time weighted average**	**Concentration in Ambient Air**	
		Industrial, Residential, Rural and Other Areas	**Ecologically Sensitive Area (notified by Central (Government)**
Sulphur Dioxide (SO2), µg/m^3	Annual* 24 hours**	50 80	20 80
Nitrogen Dioxide (NO2), µg/m^3	Annual* 24 hours**	40 80	30 80
Particulate Matter (size less than 10 µm) or PM_{10} µg/m^3	Annual* 24 hours**	60 100	60 100
Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$ µg/m^3	Annual* 24 hours**	40 60	40 60
Ozone (O3) µg/m^3	8 hours* 1 hour**	100 180	100 180
Lead (Pb) µg/m	Annual* 24 hours**	0.50 1.0	0.50 1.0

Carbon Monoxide (CO) mg/m^3	8 hours* 1 hour**	02 04	02 04
Ammonia (NH_3) $\mu g/m^3$	Annual* 24 hours**	100 400	100 400
Benzene (C_6H_6) $\mu g/m^3$	Annual*	5	5
Benzo(a)Pyrene (BaP)- particulate phase only, ng/m^3	Annual*	1	1
Arsenic(As), ng/m^3	Annual*	6	6
Nickel (Ni), ng/m^3	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

At present , the district lacks the basic instrumentation to access the air pollution level.No air quality data is available for the district,not even for the urban areas (Table 37). Major sources of air pollution are some industrial units, forest fires, vehicular pollution,burning of waste etc.(Table 38).

Some meaures have been taken by district administration in addressing the issue of air pollution in the district which includes notices for industries not adhering to the air quality norms, establishment of PUC centres to check vehicular pollution etc.(Table 39).

Table 37. Air quality monitoring and data accessibility

Action Area	Outcomes
Number of automatic air quality monitoring stations in the district	Yet to be installed
Number of manual air quality monitoring stations in the district	Yet to be installed
Availability of air quality monitoring data	Ample readings are not taken to provide necessary information about prevalent air quality standards.

Table 38. 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).
Identification prominent sources of air pollution in the district	Unprecedented forest fires, some small scale industries and vehicular pollution are major sources ofair pollution in the

	district.
Industrial air pollution	The district has one industrial estate and a few small scale industries.Out of these industrial units,12 have been foundviolating air pollution norms.
Non-industrial air pollution	
Open burning of waste	Open burning of waste is strictly prohibited in the urban areas of the district. However due to lack of waste management system in the rural areas,waste burning is still prevalent.
Forest fires	Forest fires gulps the district in every dry season.It leads to loss of hectares of forest areas.

Table 39. Control measures for industrial/ non industrial air pollution

Action Areas	Outcomes
Control of industrial air pollution	Notices have been sent to the industries that are found violating the pollution norms.
Control of vehicular pollution	03 PUC centres are available in Tehri Garhwal district.
District level action plan for air pollution	At present, no such action plan has been prepared.
Awareness on air quality	No measures taken on this aspect
Development of air pollution complaint redressal system	Not Initiated

Gap identification

The issues related to air pollution are similar to what have been in other district of the Uttarkhand. It includes the lack of air quality monitoring, no viable results regarding control of forest fires,Road dust,no intermittent strategy for mitigating elevated vehicular pollution during tourist and trekking season.

Noise pollution management

Noise pollution may be defined as 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. can 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 limit (Table 40).

Table 40. 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.

Noisepollution inTehri Garhwal district

Thus far, Noise pollution is not a major issue in the district, but installation of a monitoring station is necessary to examine the increased sound levels during festivals and other public events (Table 41).

Table 41. 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 is responsible for the implementation of the ambient noise level standards.
4.	Silent zones in the district	No place in the district is declared as silent zones.
5.	Setting up of sign Boards	Sign boards are installed around hospitals, schools and along the highways by the concerned authorities.

ILLEGAL SAND MINING

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 numbers 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, Forest & Climate Change (MoEF&CC) has put forward the sustainable sand management guidelines (SSMG) 2016, which underlines the management of sand mining in 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 (MoEF&CC) in 2020, which focuses on 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.

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

Current standpoints regarding mining activities in the district

River bed mining is prevalent in the district owing to the large flood plains of major rivers.Total 21 mining sites have been given license to operate in the district out of which as much as 18 are currently operational (Table 42). Currently the operational mining sites claim adherence to the prescribed environment norms (Table 43).

Table 42. Prevalent Mining Activities

Total area of District(km^2)	4080
Type of Mining Activity	River bed mining mining (mainly sand) is prevalent in the district.
Total no of sand mining sites in the district	There are total 21 sand mining sites are there in the district out of which 17 sitesare operational in the district.
Number of mining licenses given by the district authority	17
Action against illegal mining activities in the district (*in the financial year 2020-21*)	18
Penalties charged for the illegal mining activities	So far,penalities worth Rs. 27,76,96,015(close to 28 crores) have been imposed for illegal mining activites in the district.

Source: Geology and mininig unit, Tehri Garhwal

Table 43. Compliance with environmental standards

Mining areas meeting environmental clearance conditions	All
Mining areas meeting consent conditions of UKPCB	17
Mining operations were suspended for violations of environmental norms	NA
Pollutions related complaints against mining operations in past one year	NA

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 water bodies also play a vital role to improve the water quality and storage of surface runoff water. For these reasons we must need to store, manage and rejuvenate the existing water bodies. We can use several government policies/Schemes like Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), Atal BhujalMission 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)*

Activities undertaken for the rejuvenation of water bodies in the district

Various measures are taken in the district for the restoration of conventional water sources which 0f rainwater retention structures such as Chal-Khal, Contour Trenches and Ponds for groundwater recharge along with the plantation of the broadleaf trees which bring water to the subsoil (Table 44). The execution of these activities needs a multidisciplinary approach as it requires coordination among multiple government departments along with the local citizens.

Table 44. Present scenario in the district

Technique Used In The District For Rejuvenation Of Water Bodies	To rejuvenate water bodies following works are done under various schemes such as MNREGA: • *Construction of recharge pits* • *Construction of Infiltration trenches* • *Construction of chal-khals* • *Construction of Staggered contour trenches* • *Construction of Wooden Check dam* • *Construction of Check dam* • *Construction of Recharge ponds* • *Plantation drives* • *Pit digging for fodder plants* • *Earthen Works*

Plant Species used For Rejuvenation of Water Bodies	• Banj *(Quercus leucotrichophora)* • Bhimal *(Grewia optiva* • Kachnar *(Bahunia purpuria)* • Burans *(Rhododendron arborium)* • Utis *(Alnus nepalensis)*
Local action plan For rejuvenation of waterbodies	The district is running a water conservation and augmentation program in which the conservation of water sources, rural ponds, Chal-Khals and traditional water sources are being renovated in the gram panchayats of the district.

The Heval River Landscape Rejuvenation Project

The Heval River is one of the many tributaries of the River Ganga which originates in the Forests of Khuret and at an altitude of about 2690 m in Tehri Garhwal District. The Khuret gaad joins the Pujaldi gaad and Saur gaad at the Kaddukhal area and becomes the Heval River. It is a spring-fed river unlike other major rivers in the district which have glacial origins. It is an important river that provides water for drinking purpose and Irrigation for the rich agricultural belt downstream. The river has gained public attention in recent years due to decreased discharge owing to overexploitation, climate change, and activities like road cutting that disrupt the groundwater recharge mechanisms. The work is being executed by the Narendranagar Forest Division, Muni Ki Reti, over a 49.2 km length of the River. A catchment area of 16, 481 Hectares has been identified and 9 micro-watersheds including 38 springs and 15 streams have been surveyed for the project. A three-pronged strategy has been adopted to redress the issue:

1. A comprehensive approach that includes all aspects of the river landscape and provides solutions in a scientific manner that mimics natural systems of restoring water regimes.
2. Sustainable solutions to solve immediate needs and also create convergence systems that ensure sustained water yield for the future.
3. Engaging and empowering/capacity-building of the local community

The primary goal of the project is to rejuvenate the dying river and recharge the groundwater through the revival of existing springs. The scope of activities identified includes revival of springs, stream-shed treatment, afforestation, river bed management, and Livelihood-related convergence activities.

Fig. 8. Various Restoration works undertaken under Heval River rejuvenation project

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. Its broad range of application is in packaging films, wrapping materials, shopping and garbage bags, fluid containers, clothing, toys, household and industrial products, building materials, etc. 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.).*

Plastic products have become an integral part in our daily life pertaining to the fact that its production has crossed 150 million tons per year globally *(CPCB, 2013).* India generates 15 million tons of plastic waste every year but only one fourth 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).*

India is committed to take action for mitigation of pollution caused by littered Single Use Plastics. In the 4th United Nations Environment Assembly held in 2019, India has piloted a resolution on addressing single–use plastic products pollution, recognizing the urgent need for global community to focus on this very important issue. The adoption of this resolution at UNEP was a significant step.

Keeping in view the adverse impacts of littered plastic on both terrestrial and aquatic ecosystems, the MOEF&CC has notified the Plastic Waste Management Amendment Rules,2021, which prohibits identified single use plastic items which have low utility and high littering potential by 2022.Salient features of this amendment are as follows:

- The manufacture, import, stocking, distribution, sale and use of single-use plastic, including polystyrene and expanded polystyrene, commodities shall be prohibited with effect from the 1st July, 2022.
- In order to stop littering due to light weight plastic carry bags, with effect from 30th September, 2021, the thickness of plastic carry bags has been increase from 50 microns to 75 microns and to 125 microns with effect from 31st December,2022. This will allow reuse of plastic carry due to increase in thickness.
- The plastic packaging waste, which is not covered under the phase out of identified single use plastic items, shall be collected and managed in an environmentally sustainable way through extended producers responsibility of the Producer, Importer and Brand Owner(PIBO). For effective implementation of Extended Producer Responsibility, the guidelines for extended

producer responsibility being brought out have been given legal force through Plastic Waste Management Amendment Rules,2021.

- The State government and concerned Central Ministries and associated departments have also been requested to develop a comprehensive Action plan for elimination of single use plastics and effective implementation of Plastic Waste ManagementRules,2016 and its execution in a time bound manner.
- Directions under Section 5 of Environment(Protection) Act, 1986, have been issued to all state for setting up for institutional mechanism for strengthening enforcement of Plastic Waste Management rules,2016.

Current scenario of Plastic waste in Tehri Garhwal District

Plastic waste forms the part of dry waste and is segregated by secondary waste management operations. The estimated quanity is less compared to the total solid waste generation in the district (Table 45). Plastic waste is streamlined in current waste management operations in the district, be it door to door collection or transportation or recycling.The ULBs performing semi-automated waste management operations have plastic waste compactor which eases the further transporation of waste. Plastic waste is sold to local rag pickers by the ULBs monthly (Table 46).

Table 45. 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 Muni Ki Reti	28636	11	1.0
NPP Tehri	24014	11	0.200
NPP Chamba	10457	09	0.333
NPP Narendranagar	6049	07	0.100
NPP Devprayag	2868	04	0.200
NP Chamiyala	5017	07	0.200
NP Ghansali	3154	07	0.204
NP Kirtinagar	2517	04	0.005
NP Gaja	2098	04	0.200
NP Lambgaon	1061	04	0.040

Table 46. Present infrastructure for plastic waste management operations

Name of ULB	Inventory of infrastructure available for plastic waste management operation		
	Availability of plastic compactor	Linkage with Plastic waste recyclers	Remarks

NPP Muni Ki Reti	Available	Established	Nagar Palika has earned 1.68 lakhs/monthly by selling the waste to the recyclers.
NPP Tehri	Available	Not Established	• Nagar Palika has earned 0.20 lakhs/monthly by selling the waste to the recyclers. • 10 wards are bin free out of 11 wards.
NPP Chamba	Available	Established	Nagar Palika has earned 0.30 lakhs/monthly by selling the waste to the recyclers.
NPP Narendranagar	Available	Not Established	Nagar Palika has earned 0.20 lakhs/monthly by selling the waste to the recyclers.
NPP Devprayag	Available	Not Established	Nagar Palika has earned Total 1.20 lakhs by selling the waste to the recyclers from 2015 to till now.
NP Chamiyala	Not available	Not Established	Nagar Palika has earned 0.30 lakhs/monthly by selling the waste to the recyclers.
NP Ghansali	Available	Not Established	Nagar Palika has earned 0.15 lakhs/monthly by selling the waste to the recyclers.
NP Kirtinagar	Not Available	Not Established	Nagar Palika has earned 0.06 lakhs/monthly by selling the waste to the recyclers.
NP Gaja	Not Available	Not Established	Nagar Palika has earned 0.03 lakhs/monthly by selling the waste to the recyclers.
NP Lambgaon	Not Available	Not Established	Nagar Palika has earned 0.06 lakhs/monthly by selling the waste to the recyclers.

Identification of Gap

As Plastic waste is a part of Municipal Solid waste, the impediments are more or less same as mentioned in (Table10).Most of the ULBs have compactor for plastic waste compressing operations but minimal or no linkage with authorized recyclers have hindered the effective plastic waste recycling in the ULBs.Moreover,linkage with Public relation officer(PROs) of producers is missing which hampers the Extended Producer Responsibility (EPR).

Projected Plastic waste generation in Tehri Garhwal 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.

Projecting waste quantities in coming future is a difficult task. It is because of its changing composition over the seasons and periods due to ever changing dietary habits, economic conditions of the people and pandemic situation like COVID-19 in the concerned region. Crop harvesting season with adequate availability of a variety of food also affect the plastic generation. Lower is the level of economic development, greater will be the change between plastic waste generation and disposal. Moreover, COVID-19 like pandemic situation also caused remarkably plastic waste generation for creating medical tools and devices. These could be syringes, insulin pens, intravenous line (IV), surgical gloves, catheters, inflatable splits etc.

Census population data for the years 2001 and 2011 has been taken for population forecast (Table 47). Decadal population and subsequent waste forecasthas been done based on the following presumptions:

- Arithmetic increase method is used for the decadal population forecast, hence the rate of change of population with time is assumed constant.
- The per capita generation of plastic waste was estimated to be 11 kg/annum(Centre for Science and Environment, 2019).
- It is assumed that 70% of the total plastic waste consumed 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)*
- This analysis included population and waste generation estimations for only urban local bodies and did not include peri-urban and rural areas (Table 47 and 48, Fig.10).

Table 47. Projected Population and Waste Generation

ULB	**Projected Population**			**Present/Projected Waste Generation (MTPD)**		
	2021	**2031**	**2041**	**2021**	**2031**	**2041**
NPP Muni Ki Reti	37948	47260	56572	1.00	3.24	10.08
NPP Tehri	22605	21196	19787	0.20	0.49	1.18
NPP Chamba	8962	10153	11344	0.33	0.98	2.85
NPP Narendranagar	6794	7539	8284	0.10	0.29	0.82
NPP Devprayag	2129	2106	2083	0.20	0.51	1.32
NP Ghansali	3855	4556	5257	0.204	0.63	1.88
NP Kirtinagar	1994	2471	2948	0.005	0.02	0.05
			Total	***2.04***	***6.16***	***18.18***

Table 48. Decadal Change in plastic waste Generation

Name of ULB	Rate of growth % (2021-2031)	Rate of growth % (2031-2041)
NPP Muni Ki Reti	22.38	21.12
NPP Tehri	14.38	14.27
NPP Chamba	19.46	19.05
NPP Narendranagar	18.85	18.57
NPP Devprayag	15.72	15.72
NP Ghansali	20.73	20.00
P Kirtinagar	22.22	21.02

Fig. 9. Graphical Representation of Projected Plastic waste

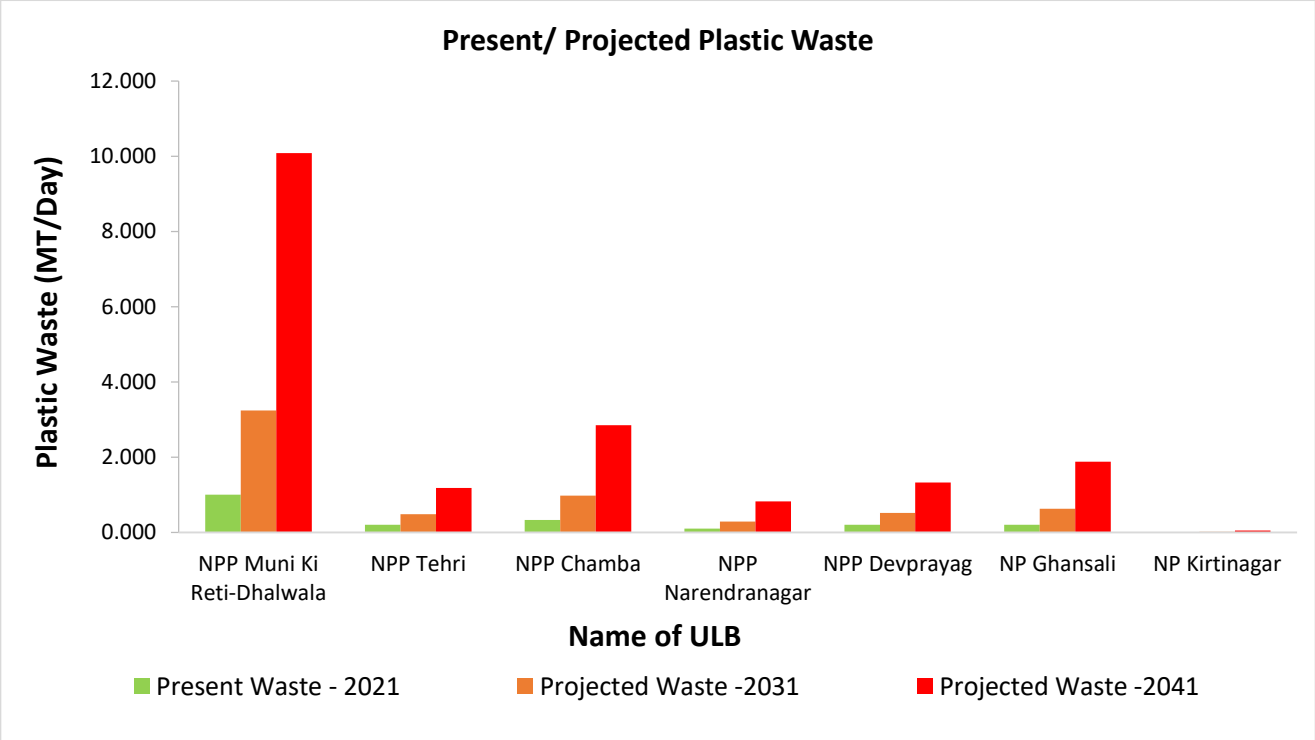


Fig. 10. Graphical representation of Projected Plastic waste

Inferences drawn from the Projection of waste

- Total waste generation is expected to surpass 18 MTPD by 2040 with maximum growth in NPP Munni Ki Reti.
- Plastic waste generation might vary on seasonal basis in the district due to heavy tourists and pilgrims influx during Char Dham Yatra season.
- Growth in plastic waste generation in the district is observed to be less compared to other districts of the state.However,floating waste and road side littering may require some interventions by the administration.

ASSESSMENT OF URBAN LOCAL BODIES IN TEHRI GARHWAL 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 49 and 50). 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.

Table 49. Assessment of Urban Local Bodies in Tehri Garhwal District

Indicators	**Maximum Points**	**Urban Local Body**									
		NPP Muni Ki Reti	**NPP Tehri**	**NPP Chamba**	**NPP Narendranagar**	**NPP Devprayag**	**NP Chamiyala**	**NP Ghansali**	**NP Kirtinagar**	**NP Gaja**	**NP Lambgaon**
Solid Waste Management											
Segregation	**4**	3	3	3	4	3	4	4	3	3	4
Collection	**4**	4	4	4	4	4	4	4	4	4	4
Segregated Waste Transport	**4**	3	3	3	4	3	4	4	3	4	4
Wet Waste Processing	**2**	2	2	2	2	2	2	2	2	2	2
Dry Waste Processing	**4**	4	2	4	2	2	0	0	2	0	0
Disposal	**2**	0	0	1	1	0	0	1	1	1	0
Inclusion of Informal Sector	**1**	1	1	1	1	1	1	1	1	1	1
Bio-medical waste Management											
Linkage with *Common Bio-medical Waste Treatment and Disposal Facility* (CBWTF)	**1**	0	0	0	0	0	0	0	0	0	0
Hazardous waste Management											
Linkage with *Treatment, Storage and Disposal Facilities* (TSDF)	**1**	0	0	0	0	0	0	0	0	0	0
C&D Waste management											
C&D Waste Processing	**1**	0	0	0	0	0	0	0	0	0	0
E-Waste Management											
E-waste collection and linkage with recyclers	**2**	0	0	0	0	0	0	0	0	0	0
General Information											
Innovation and use of indigenous techniques	**2**	1	0	0	0	0	0	0	0	2	0
Enforcement of bye-laws and waste Management Rules, 2016	**2**	2	2	2	2	2	2	2	2	2	2
Total	**30**	**20**	**17**	**20**	**20**	**17**	**17**	**18**	**18**	**19**	**17**

Table 50. Final Assessment of Urban Local Bodies of Tehri Garhwal District

Name of ULB	Score (out of 30)	Score Percentage (%)
NPP Muni Ki Reti	20	66.66
NPP Tehri	17	56.66
NPP Chamba	20	66.66
NPP Narendranagar	20	66.66
NPP Devprayag	17	56.66
NP Chamiyala	17	56.66
NP Ghansali	18	60.00
NP Kirtinagar	18	60.00
NP Gaja	19	63.33
NP Lambgaon	17	56.66

Observations from data assessment

- All though the ULBs are doing satisfactory waste management operations, disposal of the waste requires some attention.
- NPP Munni-ki-Reti,Chamba, Narendranagar and NP Gaja are performing better compared to other ULBs of the district, precisely in the waste recovery.
- Wet waste composting is optimum in all the ULBs of the district.
- None of the Urban Local Bodies has linkage with Treatment Storage and Disposal facility (TSDF) for the handling of municipal sanitary waste and domestic hazardous waste respectively.

ACTION PLAN

Action plan for Solid waste management

Focus Areas

- *Setting up of Material recovery facility in a cluster based approach.*

Tehri Garhwal district is performing well in primary waste management operations. Processing of waste or secondary segregation is mostly perfomed in manual way but is still effective and optimum.

Based on analysis of data, this action plan defines the areas where each ULB needs to work based on their current waste management operations (Table51). This is a holistic plan which defines action areas based on gap assessment of each ULB. Each action point is in compliance with the guidelines of Solid Waste Management rules, 2016

Table 51. Action plan for solid waste management

Action areas	Concerning ULB	Purpose	Strategy/Approach	Stakeholder Responsible
Primary segregation (Segregation at source)	NPP Tehri and NP Kirtinagar	• Increasing the recovery level of recyclable waste. • Reduction of capital, energy and land requirement for waste management.	• Separate Storage Bins in every households and commercial places. • Regular awareness campaigns • Man power management. • Behavioural change	• Nagar Palika Parishad/ Nagar Panchayat • Residents and private agencies/ NGOs
Segregated waste transport.	NPP Tehri and NP Kirtinagar	• Reduction of open dumping of waste. • Reducing the carbon footprint and greenhouse gas emissions. • Reduction of transportation charges.	• Optimizing waste management infrastructure (collection trucks, trolleys). • Man power optimization at recovery facility.	Nagar Palika/ Nagar Panchayat
Dry waste Management through waste processing plant/Material recovery facility.	All ULBs except: Munni-ki - Reti	• Scientific management of dry waste. • Higher waste Recovery	• Establishing Material Recovery facility • Linkage with recyclers	Nagar Palika/Nagar panchayat/Township administrator

Treatment Storage and Disposal Facility (TSDF) and Common Biomedical Waste Treatment Facility (CBMWTF)	All ULBs	Proper disposal of municipal sanitary waste and domestic hazardous waste.	• Separate bins for sanitary and domestic hazardous waste. • Establishment linkage with nearby TSDF and CBMWTF.	Nagar Palika/Nagar Palika Parishad/ Nagar Panchayat
Linkage with authorised Recyclers	All ULBs except NPP Muni-Ke-Reti and NP Chamba	Ensuring scientific handling and recycling of dry waste.	Either the local scrap pickers can be authorised or direct linkage could be established with any recycling unit.	Nagar Palika Parishad/ Nagar Panchayat
Cluster based approach to solid wastemanagement	All ULBs	• Clubing the villages in peri-urban areas of the town with the nearby solid waste management facility for effective waste management in rural areas. • Execution of Rurban Mission of Government of India.	By merging schemes from Central and state government department with Rurban Mission of Ministry of Rural development	District administration District Panchayati Raj Officer (DPRO)
Community participation for waste management	All ULBs	• Social and Behavioural Change Communication • Cleanliness drive campaigns throughout the district	• Information, Education and Communication (IEC) activities in Educational institutions. • IPC (Inter-personal communication): School children and Sanitation workers to spread awareness amongst people regarding waste management.	District Administration

Establishment of Green Protocol	All ULBs	• Prevent the use of disposables and using alternatives like glass/Stainless steel etc. • To bring generation of non-biodegradable waste close to zero.	By encouraging Green protocol in local schools, public functions, IEC campaigns, sports events, annual temple festivals and other gatherings.	District Administration

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 52).

Table 52. Suggested vegetation for reclaiming landfill sites in Tehri Garhwal district

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	Kumar et al, 2021
Bauhinia variegata L.	Kachnar	Tree	Absorbs Zn, Hg, As, Pb, Cu and Cd from wastewater	1250-1800	Agarwal et al 2011
Bauhinia acuminata L	Kachnar	Tree	conversion of Hg to volatile chemical from groundwater	1150-1500	Agarwal et al 2011
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	Khan et al, 2019
Berberis asiatica Roxb. ex DC.	Kilmora	Shrub	Absorbs all the dissolved gases.	1650-2400	Khan et al, 2019
Cynodon dactylon (L.) Persoon	Dubla, Doob	Herb	Absorbs Arsenic and Fluoride from wastewater	700-2500	Sekabira et al, 2011

Azolla pinnata R. Br.	Azolla	Herb	Control the Hg, and Cd from wastewater also known as bio-fertilizer	400-2200	Kumar et al, 2020

Action Plan for rural waste management in India

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

Presently in Tehri Garhwal 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 53).

Table 53. 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 an appropriate number of toilet seats, bathing cubicles etc.(Only where there is a lack of space in the village for the 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 a cluster of Gram panchayats that demonstrate economic growth potentials.
Community Participation through Information, Education and Communication (IEC) 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 Biomedical waste management

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.

Focus Areas

- *Authorisation of HCFs with State Pollution Control Board*
- *Linkage of ULBs with major HCFs for disposal and processing of biomedical waste generated from domestic households*

Some HCFs have linkage with common CBMWTF which is hard to see in the hilly districts of Uttarakhand. Still some basic management techniques should be ensued in current biomedical waste management operations to effectiviely processing and disposal.

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 54).

Table 54. Action plan for bio-medical waste

Action Areas	Purpose	Stakeholders
Governance		
Periodic inspection of HCFs *(Health-care Facilities*) by UKPCB *(Uttarakhand state Pollution control board).*	To ensure proper segregation of Biomedical waste as per Biomedical waste management rules, 2016.	Uttarakhand state Pollution control board
Linkage of ULBs with CBWTF *(Common Biomedical waste treatment facility).*	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 and CHCs.	To ensure proper segregation of Biomedical waste into different categories as specified under Biomedical waste management rules,2016.	Health Department
Installation of effluent treatment plants in district level HCFs and CHCs.	To ensure disposal 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
• Setting up of Biomedical Waste Database at State level *(specifically for primary health-care facilities)* • Training on (BMWMIS) *(biomedical waste management information system)* to all data entry operators and pharmacists.	To keep records of biomedical waste generated in every HCF of the district *(especially 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 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 segregation at each generation point and 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 UKPCB*(Uttarakhand state Pollution control board).*
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 data management system to keep inventory of waste collection, consumables supply, training programs etc. in HCFs *(including PHCs in the district)*	To ensure transparency in the biomedical waste management system up to primary level.	Health Department
Display details of authorisation, 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 C&D Waste management

Currently. C&D waste is used locally by most of the ULBs of Tehri Garhwal district.But it may not be a feasible option for future considering the urbanization rate in the country.Hence, some basic facilities need to be developed to manage its growth. The action plan provides below (Table55) 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

- *Considering C&D waste as a separate stream for its effective management.*
- *Framing of bye-laws*

Table 55. Action plan for C&D waste management

Action Point	Purpose	Strategy/Approach	Stakeholder Responsible
Setting up of C&D waste dumping site for local construction activities and road construction debris.	To ensure compliance with C&D Waste Management Rules 2016.	• Establishment of dumping zone such that it also caters for C&D waste 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 in district road, village road.	• All ULBs and *District Panchayati Raj officer* (DPRO) • *Public Works Department*(PWD)
Coordination and Collaboration amongst different departments.	To manage C&D waste in addition to other municipal garbage, if there is no consolidated Solid Waste management department.	Close coordination between Sanitary department, Municipal Engineering Department and Town planning department is required for efficient management of C&D Waste management.	• All ULBs • Public Works Department (PWD)
Framing by-laws for C&D waste management.	To ensure compliance with C&D Waste Management Rules 2016.	• 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)

Action Plan for Hazardous Waste

Currently ,only hazardous waste from the industries is inventoried in the district by State Pollution Control Board.Domestic Hazardous waste which alos can be a potential threat to human health and environment exist as mixed waste. This makes it necessary to manage hazardous waste to minimize its harmful impact..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 (Table 56).

Focus Areas

- *Biomining to reduce the toxic effects of Hazardous waste.*

Table 56. Action plan for Hazardous waste

Action Point	Purpose	Strategy/Approach	Stakeholder Responsible
Linkage of ULBs with common Treatment, Storage and Disposal Facilities (TSDF) or disposal facility	To ensure segregation of domestic hazardous waste from municipal solid waste and its proper disposal.	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. One Collection facility should be setup in the district to collect domestic hazardous waste from the rural areas of the district.	All ULBs & DPRO*(District Panchayati Raj officer)*
Training of sanitation workers regarding segregation of domestic hazardous waste	To ensure segregation of domestic hazardous waste from municipal solid waste	Training programme should be organised at state/district 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
IT enabled systems for inventorization of the hazardous waste m	To ensure compliance to Hazardous waste management rule 2016.	State pollution control board should inventories 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

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 57)

Table 57. Action plan for E-waste

Action Point	Purpose	Strategy/Approach	Stakeholder Responsible
Establishing E-waste Collection Centres	• To ensure proper segregation of E-waste from municipal solid waste • Capacity building of stakeholders to promote effective E-waste management.	• 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
Authorization of E-Waste Pickers	To avoid illegal trading and processing of e-waste.	Authorization of E-waste pickers should be done by district administration and urban local bodies. For that, Identity cards should be issued to them.	District administration and ULBs
Linkage of ULBs with authorized recyclers/ Dismantlers	To ensure proper recycling if possible and if not then proper disposal as per E-waste management rule 2016.	All the ULBs in the district should establish linkage with any of the five authorized E-waste recyclers.	All ULBs
District level Awareness campaign	Promoting behavioural change in public.	• 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 Technology) about alternate methods of disposing E-waste.	District administration

Extended Producer Responsibility	• Proper Collection and Disposal of E-waste • Channelization of e-waste generated from the "end-of-life" products to ensure environmentally sound management	• Random sampling of electrical and electronic equipment's placed on market to monitor and verify the compliance of Restriction of Hazardous Substances(RoHS) 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

Action Plan for Waste Water Management (STPs)

Several STPs are operational under flagship project "National Mission for Clean Ganga" (NMCG) .Prime focus is to improve riverine ecology by scientific management of waste water. At present,interception and diversion works including tapping of major drains are in progress. Site specific wastewater management will be the next in addressing the issue of excessive sludge and waste water generated.

Focus Areas

- *Sewer network to connect domestic households.*
- *Site specific wastewater management*

This action plan focusses on addressing concerns of each ULB pertaining to the policies and design sanctioned by the respective administration. (Table 58).

Table 58. Action plan for waste water management

Action areas	Concerning ULB	Strategy/Approach	Stakeholder Responsible
Upgradation of Sewer Network	NPP Muni ki Reti	• Reconnaissance survey of rest of the ULB. • Preparation of estimation for the required sewer network to receive the financial grant from the government. • If off-site sanitation is not financially viable then septage management is also one of the possible option by upgrading the existing STPs for co-treatment.	Jal Nigam/Jal Sansthan
Continuous Effluent Monitoring station	All ULBs	• Self-monitoring mechanism in the form of Online Continuous effluent monitoring system.	• Jal Sansthan • State Pollution control board
Decentralized waste water management under Atal mission for Rejuvenation and Urban transformation(AMRUT) by Faecal Sludge and Septage Management system (FSSM)	As per feasibility analysis	• 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
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

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 59).

Table 59. Mitigation Measure *for domestic waste water.*

Botanical name	Local name	Assimilating capacity	Remarks
Ipomoea aquatic Forssk.	Water spinach	Removal of TN and TP, *Ipomoea aquatica* (water spinach) has thriving roots and high growth rates and has high capacities to absorb nitrogen, phosphorus, and other nutrients or pollutants	Tang et al, 2020
Persicarialapathifolia (L.) Delarbre		Removal of BOD, COD, nutrient, metal	Rudin et al, 2016
*Canna indica*L.		Ecological floating bed for removal of nutrients	Barya, 2020
Iris pseudacorus L.		Ecological floating bed for removal of nutrients	
Accords calamus L		Ecological floating bed for removal of nutrients	
Typha domingensis Pers.		Decrease in BOD, COD and total organic carbon (TOC) was observed.	Gomber et al, 2013
Leptochloa fusca(Lam.) N.Snow	Southern Cattail	Decrease in BOD, COD.	Yasin et al, 2021
Brassica juncea (L.) Czern.	Sarso	Used to remove As, Pb, and Cd concentration in contaminated soil	Yasin et al, 2021

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

Water Resources and Groundwater management requires an integrated approach from different departments such as the 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 60 and61)

Focus Areas

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

Table 60. Water Resources management

Action Point	Purpose	Strategy/Approach
Integrated water resources management (IWRM) at River basin level	To achieve water security for all purposes,managing risks and to mitigate disasters	By Considering basin/sub basin as a basic unit for planning and management.
River Basin Master Plan	Periodic review of hydrological conditions prevailing over a basin Identification of protected areas	By analysing River Basin Characteristics
Mapping of water scarce areas in a district	To get estimate of vulnerable areas in the district.	• By using modern mapping tools such as *Geographical Information System*(GIS) and Remote sensing • By setting up an interdisciplinary framework consisting of Local institution and empowered government agency
Assessment of water Resources in various river basin	To collect reliable data To assess water resources potential and analysing water requirements for various uses,	Using Modern technology and Hydrological modelling
Public Awareness and use of Low Cost technologies	For better water application efficiency	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.

Integrated Rural area Programme*(IRAP)*	• For constant interactive relationships between different departments • Location specific programmes can be drawn up locally under this overall programme.	By bringing together all the programmes of different ministries as well as rural employment and development programme into one for effective collaboration and planning.

Table 61. Ground water management

Action Point	**Purpose**	**Strategy/Approach**
Multidisciplinary Approach(Nexus between groundwater,agricultural policy,urban infrastructure and energy consumption)	For groundwater sustainability	By integrated vision and coordination amongst different departments.
Mapping of aquifer at micro level	• To quantify the available ground water resources • To formulate plan appropriate to the scale of demands and aquifer characteristics.	By Maintaining an Aquifer information and Management system
Artificial recharge of Ground water	• To ensure sustainability of ground water resources • To ensure the quality of recharge to prevent possible contamination	• By demarcating groundwater recharge zones by identifying critical natural recharge areas of an aquifer and those areas that require special attention with regard to recharge of groundwater. • 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 which will help develop indigenous recharge methods (such as Chal-khal).
Identification of Non-point sources of Pollution (Pollution resulting from land runoff, precipitation, drainage, seepage etc.)	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.	• Controlling soil erosion by planting more trees and covering bare soil with vegetation. • Constructing wetlands.
Mitigating Groundwater Contamination	• To ensure the ground water quality of an area. • To reduce health hazards caused due to contaminated water.	• Reducing the use of pesticides and fertilizers. • Encouraging Organic farming in the area by organising various Information,Education and Communication(IEC) campaigns.

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 62).

Focus Areas

- *Air quality monitoring*
- *Mapping of forest fire prone areas*

Table 62. Action plan for air quality management

Action Areas	Purpose	Strategies/Approach	Stakeholders
Air quality monitoring	To identify the hotspots within the district and further development of mitigation measures for those areas.	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)
Solid waste collection system	To reduce emission of harmful gases by open burning of waste especially in urban areas.	• Door to Door collection of waste in the peri-urban areas and provision of dry waste collection from rural areas within the district. • After implementing proper collection mechanism, provision of heavy fines should be made on open burning of waste.	All ULBs and DPRODistrict Panchayati Raj Office (DPRO)
Control over forest fires	To reduce harmful emissions due to massive forest fires in the district.	• 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 forests by planting indigenous broadleaf plants which maintains	Government of Uttarakhand and District Forest Department

		moisture in the soil and reduce the chances of fire.	
Vehicular Traffic management	To reduce emissions caused by vehicles.	• Checking adulteration of fuel • Promoting intercity and intra-city public transportation with green fuel alternatives such e-buses & rickshaws etc. • Paving of road shoulders especially in urban areas.	• Department of Police • Transport Department • Public works department
District level action plan for air pollution	To improve existing air quality.	A district level task force with some experts can be formed for air quality management in the district.	District Administration
Awareness on air quality	To promote awareness among the masses regarding the issue.	Mass awareness can be promoted with IEC activities by involving institutions such as schools and colleges for this purpose.	District Administration
Complaint redressal system	To sort out grievances registered by citizens	Online complaint registration and redressal system should be formed at the district level to register complaints regarding air pollution issues.	• Uttarakhand state pollution control board (UKPCB) • District administration

Action Plan for Noise pollution management

Presently, Noise pollution is not a big issue in the district. It prevails only at festive times 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. (Table63).

Table 63. Action Plan for Noise pollution management

Action Areas	Purpose	Strategies/Approach	Stakeholders
Noise level monitoring	To recognize the current situation of noise levels in the district and identify the hotspots	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)
Traffic management	To ensure noise level within permissible limits	Signboards should be placed at sensitive locations in the towns within the districts and if required silent zones should be established	• District Administration • Public Works department and

		Green belts can be formed along the roads in the urban areas to reduce noise levels.	ULBs
Complaint redressing system	To sort out grievances registered by citizens	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
Mass Awareness	To promote awareness among the masses regarding the issue	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

ActionPlan for Mining Activity

Large flood plains of the river offers huge mining potential in Tehri Garhwal district.This has to be done adhering to the rules stated by mining department. 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 64).

Focus Areas

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

Table 64. Mining activity management plan

Action Areas	Purpose	Strategies/Approach	Stakeholders
Monitoring of mining activity	To ensure sustainable mining activity within the district.	• 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
System for online purchase and sale of Sand and other RBMs	To ensure compliance to Enforcement and Monitoring guidelines for Sand mining, 2020.	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
Identification of hotspots for illegal mining	To have check on the mining activities in the district.	The district task force should identify the possible hotspots for illegal mining through surveillance and patrolling.	District Administration
Community participation	• 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.	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

Action Plan for Plastic Waste Management

Plastic waste causes a plethora of problems when it leaks into the environment. Stranded single use plastics create visual pollution. There is evidence that the toxic chemicals added during the manufacture of plastic, transfers to animal tissue, eventually entering the human food chain. Moreover, by clogging sewers and providing breeding grounds for mosquitoes and pests, plastic bags can increase the transmission of vector-borne diseases like malaria, cholera. The current policies and legislation against use of plastic in fragile Himalayan ecosystem needs revamp as most of the policies are plain centric. However, some basic action areas like source segregation, effective collection and transport requires urgent redressal. Each action point complies with the guidelines of Plastic Waste Management rules, 2016. The current action points must be addressed in a timeframe of 5-10 years considering the financial constraints (Table65).

Focus Areas

- *Linkage with authorised recylers*
- *Linkage with PROs of producers*
- *Formalization of waste pickers*

Table 65. Action Plan for Plastic waste management

Action Point	Purpose	Strategy/Approach	Stakeholder Responsible
Source segregation	• To ensure better efficiency in waste processing • Higher recovery of resources.	• ULBs should distribute separate bins to households, street vendors and other shopkeepers. • Distribution of separate bins to every 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, District Panchayati raj Officer (DPRO), Village Panchayats
Effective Collection and segregated waste transport	• To reduce open dumping of waste • To reduce monkey menace (which is a huge issue in the urban areas of the state) • To ensure optimum utilisation of manpower • To ensure compliance with plastic waste management rules 2016	• 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, District Panchayati Raj Officer (DPRO), Village Panchayats
Linkage of ULBs & other collection	• To avoid open dumping of plastic	• Plastic waste collection centre to be started in rural areas should also be	All ULBs, DPRO (District

centres with recyclers/ cement plants / Public Works Department	waste. To ensure reuse and recycle of plastic waste.	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.	Panchayati raj Officer),
Implementation of extended producer responsibility (EPR) through producer/Brand owner	To reduce the workload of 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
Community participation for waste management	Social and Behavioural Change Communication Cleanliness drive campaigns throughout the district	• 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
Establishment of Green Protocol	• To prevent use of disposables and using alternatives like glass/Stainless steel etc. • To bring generation of non-biodegradable waste close to zero.	By encouraging Green protocol in local schools, publicfunctions, IECcampaigns, sports events, annual temple festivals and other gatherings.	District Administration

CONCLUSION

The district Tehri Garhwal has certain important aspects such as efficient source segregation, door to door collection of waste, resource recovery, etc. which makes its easy for operating waste management operations at optimum level. This might be one of the reasons for some ULBs (NPP Muni Ki Reti and NP Gaja) showing exemplary performance in solid waste management. The waste management operations adhere to the SWM, 2016 rules which mandates minimum disposal and maximum recovery. A blend of scientific infrastructure help manage the ULBs for ever growing solid waste more effectively in near future. The management of biomedical waste is done through amalgamation of deep burial method by HCFs and regular lifting of waste to CBMWTF. More than 12 kg out of 46.87 kg biomedical waste is lifted by CBMWTF daily. Maximum HCFs need to be authorized by Uttarakhand State Pollution Control Board, which at present is less than average. This will help in analyzing the current biomedical waste management practices in more efficient way. As Construction activities will rise, so will be the generation of Construction and demolition (C&D) waste. The quantity is assumed to be minimal as plenty of waste is used locally in filling and reparation works. Formal management of C&D waste will be required in near future. This may be started by framing bye laws for C&D waste. Waste water management has been the utmost priority in the district due to direct intervention from the Centre government whose flagship project “Namami Gange” focuses on improving the ecological and environmental aspects of River Ganga and its tributaries. For this purpose, 09 STPs were constructed along with interception and diversion works of drains. Next phase will focus on connecting domestic households to the STPs through extensive sewer network or centralized treatment, whichever would be feasible for a particular locality. Air quality in the district is assumed to be deteriorated particularly during the months of forest fires but there is no scientific rationale supporting to it due to lack of monitoring station. District administration needs to take some steps to address the growing concern regarding air quality monitoring and this information should be available in a public domain. As far as surface and groundwater management are concerned, many issues have not been highlighted except encroachment on the river flood plains. Groundwater studies need to be conducted to know about the current situation of water table and its quality. Restoration works (such as construction of recharge pits, chal-khals, check dams. etc.) are performed in the district under different schemes envisaged by both Centre and the State Government. One such work for rejuvenation of River Heval undertaken by forest department has gained limelight in recent years. An extensive framework which includes revival of 38 springs and 15 streams has been developed by merging scientific and convergence activities to restore the flow of dying river. Spring-shed

management and watershed management practices will help achieve the goal of restoring the flow of River Heval in shorter time span. River bed mining, particularly sand mining is one of the sources of revenue for the mining department. However, illegal mining activities are also prevalent in the district which hampers the river profile and destroys riverine ecology. Eighteen actions were taken in financial year 2020-21 against illegal mining. Subsequently, penalties amounting to almost 28 crore rupees were imposed. Regular monitoring of sand mining sites and use of modern surveillance may help in reducing the illegal mining activity cases in the district.

All the aspects related to environmental plan have importance in the district of Tehri Garhwal. Such concerns need to be addressed in a scientific way so that holistic policy framework could be developed. This will require due intervention and collaboration of different departments.

घटते ग्लेशियर और जलवायु परिवर्तन खतरे के संकेत

पर्यावरण योजना की तैयारी को लेकर परामर्शी कार्यशाला का आयोजन

नई टिहरी, 15 अक्तूबर (स.ह.) : राज्य और जिले की पर्यावरण योजना की तैयारी को लेकर गोविंद बल्लभ पंत राष्ट्रीय हिमालयी पर्यावरण संस्थान के तत्वावधान में परामर्शी कार्यशाला में वीरवार को वक्ताओं ने कहा कि पर्यावरण और पारिस्थितिकीय पहलुओं के बीच में मानव को संतुलन बनाना ही होगा। जिस तरह से ग्लेशियर घट रहे हैं और जलवायु परिवर्तन हो रहा है, वह खतरे के संकेत हैं। ऐसे में सरकारों के साथ-साथ आम व्यक्ति को भी पर्यावरण संरक्षण के प्रति जागरूक होना जरूरी है।

जिला सभागार में आयोजित कार्यशाला का सीडीओ अभिषेक रूहेला ने शुभारंभ किया। उन्होंने कहा कि पर्यावरण योजना के तहत बेहतर प्लानिंग करनी होगी। नगर निकाय, जल प्रबंधन से जुड़े विभाग, वन विभाग, परिहवन, विकास विभाग सहित विभिन्न प्राधिकरण ठोस कार्य योजना बनाने के साथ ही प्रस्तावित प्रारूप को भरकर पर्यावरण संस्थान अल्मोड़ा को उपलब्ध कराएं, ताकि जिले की पर्यावरण प्लानिंग से संबंधित रिपोर्ट एनजीटी की सौंपी जा सके। जीबी पंत हिमालय पर्यावरण संस्थान के वैज्ञानिक डा. जेसी कुनियाल ने कहा कि ठोस अपशिष्ट प्रबंधन, बायोमेडिकल वेस्ट, प्लास्टिक वेस्ट मैनेजमेंट, वायु प्रदूषण कार्यों के बेहतर निस्पादन को लेकर अब हमारी जिम्मेदारी ज्यादा बढ़ गई है। नगर पालिका चंबा के ईओ एसपी जोशी ने निकायों की परेशानियों से अवगत कराया। इस मौके पर मृदा वैज्ञानिक डा. सुमित राय, ग्लेशियर वैज्ञानिक डा. कपिल कैसरवानी, डीएफओ डा. कोको रोसे, एडीएम शिवचरण द्विवेदी, ईओ चंबा एसपी जोशी, ईई जल संस्थान सतीश नौटियाल, एआरटीओ एनके ओझा आदि मौजूद रहे।

नई टिहरी में पर्यावरण योजना की कार्यशाला के दौरान वैज्ञानिक और अधिकारी।

Fig. 11. Different activities in Tehri Garhwal for preparation of District Environment Plan (Dated October, 15, 2020)

REFERENCES

Agarwal, D., Agarwal, M. K., Yunus, M., & Gautam, S. K. (2011). Phytoremediation of fly ash by assessing growth responses of the local tree species. J Pure Appl Sci Technol, 1, 123-134.

Ahmad, Z., Khan, S. M., Ali, M. I., Fatima, N., & Ali, S. (2019). Pollution indicandum and marble waste polluted ecosystem; role of selected indicator plants in phytoremediation and determination of pollution zones. Journal of Cleaner Production, 236, 117709.

Anonymous, (2016). Solid Waste Management in Rural Areas A Step-by-Step Guide for Gram Panchayats, A Companion to The Facilitators of Swachh Bharat Mission (Gramin), Centre for Rural Infrastructure National Institute of Rural Development & Panchayati Raj Rajendranagar, Hyderabad, www.nird.org.in

Anonymous, (2018). "Uttarakhand Vision 2030"Planning Commission, Government of Uttarakhand,

Attri, S.D., & Tyagi, A. (2010). Climate profile of India. Environment Monitoring and Research Center, India Meteorology Department: New Delhi, India.

Azash, S.M.D. & Thirupalu, N. (2017). Fundamental Principles of Environmental Protection and Sustainable Development, National Conference on Marketing and Sustainable Development, Vol. 13, pp 14, ISBN 978-1-943295-10-4

Azeez, N. M., & Sabbar, A. A. (2012). Efficiency of duckweed (Lemna minor L.) in phytotreatment of wastewater pollutants from Basrah oil refinery. Journal of Applied Phytotechnology in Environmental Sanitation, 1(4), 163-172.

Barya, MP., Gupta, D., Thakur, TK., Shukla, R., Singh, G., & Mishra, VK. (2020). Phytoremediation performance of Acorus calamus and Canna indica for the treatment of primary treated domestic sewage through vertical subsurface flow constructed wetlands: a field-scale study. Water Practice and Technology, 15(2), 528-539.

Central Pollution Control Board (CPCB, 2013) Overview of Plastic Waste Management,

Central Pollution Control Board CPCB (2019) Biomedical waste management as per biomedical waste management rules 2016

Chaphekar, S.B., Boralkar, D.B., Shetye, R.P. (1980) Effects of industrial pollutants on plants. Final Report of UGC sponsored project,

Dineva, S. B. (2017). Leaf blade structure of Morus alba L. and resistance to industrial pollution. Journal of Applied Forest Ecology, 5, 1-8.

District Census Handbook (2011) District Census Handbook Almora, Census 2011, http://www.censusindia.gov.in/2011census/dchb/0507_PART_A_DCHB_ALMORA.pdf

District Statistical Report (2018) District statistical Handbook 2018, Almora, https://almora.nic.in/document-category/statistical-report/,

Electricals & Electronics Manufacturing in India (2018) NEC Technologies India Private Limited,

Forest Survey of India (FSI, 2019) An Assessment Report on Forest Cover Status of India. Government of India: Ministry of Environment and Forest (MoEF); Forest Survey of India Dehradun, https://fsi.nic.in/forest-report-2019.

Gajananda, Kh., Kuniyal, J.C., Monin, G.A., Rao, P.S.P., Safai, P.D., Tiwari, S. and Ali, K. (2005) Trend of atmospheric aerosols over the north western Himalayan region, India, *Atmospheric Environment* 39(27): 4817-4825; ISSN: 1352-2310.

Groundwater Year Book India 2019-20 (2020) Central Ground Water Board (CGWB), Ministry of Jal Shakti, Department of Water Resources, River Development and Ganga Rejuvenation, Government of India,

Janta, R., Chantara, S., Inta, A., Kawashima, M., & Satake, K. (2016). Levels of road traffic heavy metals in tree bark layers of Cassia fistula tree. International Journal of Environmental Science and Development, 7(5), 385.

Kumar, A., Kumar, P., Singh, H., & Kumar, N. (2021). Adaptation and mitigation potential of roadside trees with bio-extraction of heavy metals under vehicular emissions and their impact on physiological traits during seasonal regimes. Urban Forestry & Urban Greening, 58, 126900.

Kumar, V., Kumar, P., Singh, J., & Kumar, P. (2020). Potential of water fern (Azolla pinnata R. Br.) in phytoremediation of integrated industrial effluent of SIIDCUL, Haridwar, India: removal of physicochemical and heavy metal pollutants. International journal of phytoremediation, 22(4), 392-403.

Kuniyal, J.C. (2005a) Solid waste management techniques for the waste generated and brought down from campsites in the hill spots, trails and expedition tops, *Waste Management and Research* 23(3): 182-198; ISSN: 0734-242X, Online ISSN: 1096-3669.

Kuniyal, J.C. (2005b) Solid waste management in the Himalayan trails and expedition summit, *Journal of Sustainable Tourism* 13(4): 391-410;ISSN 0966-9582 (print), 1747-7646 (online).

Kuniyal, J.C., Thakur, H.K. (2013-14) *User manual on microbial biocomposting technique for solid waste management*, G.B. Pant Institute of Himalayan Environment and Development, Shamshi-Kullu, pp. 1-34.

Nagendran R., Selvam A., Joseph K., Chiemchaisri, C. (2006) Phytoremediation and rehabilitation of municipal solid waste landfills and dumpsites: a brief review, *Waste Manage* 26:1357–69.

Pal, S.S., Kansal, A., Rawat, T. (2018) Bio-medical waste in Pandemic COVID 19 Uttarakhand UKPCB, *ENVIS Newsletter*16(2): 1-6.

Paliwal, H. B., Gupta, N., & James, A. (2014). Study on accumulation of lead in sunflower (Helianthus annuus), Journal of Industrial Pollution Control, 30(1). 91-96.

Prajapati, S.K. (2012) Bio-monitoring and speciation of road dust for heavy metals using *Calotropis procera* and *Delbergia sissoo*"*Environmental Skeptics and Critics* 1(4): 61-64.

Rathore, SS., Shekhawat, K., Dass, A., Kandpal, BK., & Singh, VK. (2019). Phytoremediation mechanism in Indian mustard (Brassica juncea) and its enhancement through agronomic interventions. Proceedings of the National Academy of Sciences, India Section B: Biological Sciences, 89(2), 419-427.

Rissato, S.R., Galhiane, M.S., Fernandes, J.R., Gerenutti, M., Gomes, H.M., Ribeiro, R., & Almeida, M.V.D. (2015). Evaluation of Ricinus communis L. for the phytoremediation of polluted soil with organochlorine pesticides. BioMed research international, 2015.

Samant, S.S., Dhar, U., Rawal, R.S. (1998) Diversity and distribution of wild edible plants of Indian Himalaya. In: Plant diversity of the Himalaya, edited by PC Pandey & SS Samant, Gyanodaya Prakashan, Nainital, pp. 421-482.

Sekabira, K., Oryemndash, H., Mutumba, G., Kakudidi, E., & Basamba, T. A. (2011). Heavy metal phytoremediation by Commelina benghalensis (L) and Cynodon dactylon (L) growing in urban stream sediments. International Journal of Plant Physiology and Biochemistry, 3(8), 133-142.

The Groundwater Foundation (2020) National Groundwater Association, Accessed website (17 May 2020).

The sub-national Water Stress Index (2019) formulated by London-based risk analytics firm Verisk Maplecroft,

UNDP Report, (2018-2024) Plastic Waste Management Programme, United Nations Development Programme (UNDP), place and pp

Vazquez, S., Martín, A., Garcia, M., Espanol, C., & Navarro, E. (2016). Metal uptake of Nerium oleander from aerial and underground organs and its use as a biomonitoring tool for airborne metallic pollution in cities. Environmental Science and Pollution Research, 23(8), 7582-7594.

Wetlands of Uttarakhand (2012) Report jointly published by the Uttarakhand Forest Department and WWF India,

Website Used

https://in.nec.com/en_IN/pdf/