DRAFT

DISTRICT ENVIRONMENTAL PLAN

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

CHAMPAWAT

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

Hon'ble National Green Tribunal (NGT) vide order, dated 26/09/2019 in O.A. No. 360 of 2018 filed by Shree Nath Sharma Vs. Union of India and Others directed that Central Pollution Control Board (CPCB) shall facilitate the District Magistrates in preparation of the District Environmental Plan 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, 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 (MoEF&CC) shall prepare a National Environmental Plan, under the supervision of Secretary, MoEF&CC 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 Govt of Uttarakhand were included under district plan. These 14 areas were regarding compliance to rules for: solid waste including legacy waste, bio-medical waste, construction & demolition waste, hazardous waste, E-waste, polluter stretches, non-attainment cities, industrial clusters, status of sewage treatment plants (STPs) and re-use of treated water, 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 SPCB.

Implementation of the environment plan based on fundamental indicators will do noticeably more to ensure that these objectives are achieved and our compliance obligations are met. It will also allow environmental opportunities associated with our activities to be further explored and undertaken. Environmental plan describes how action might impact the natural environment in which it occurs and set out clear commitments how those impacts will be avoided, minimized, and managed so that they are environmentally acceptable. We hope this document will act as an easy reference for various stakeholders interested in progression of sustainable development planning for the Champawat district. Moreover, it will help develop a comprehensive understanding of environmental planning process, which has gone into development of the area over the period. Finally, it briefly touches upon the imminent need for bringing in mountain perspective in developmental planning for the district.

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Principal Investigator, Co Principal Investigators & Project staff

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ABBREVIATIONS

AMRUT	-Atal Mission for Rejuvenation &Urban Transformation
APL	-Above Poverty Line
AR	-Assessment Report
As	-Arsenic
BMWMIS	-Biomedical Waste Management Information System
BPL	-Below Poverty Line
C	-Carbon
C&D waste	-Construction & Demolition waste
CACMP	-Catchment Area Conservation Programme
CAGR	-Compound Annual Growth Rate
CAMPA	-Compensatory Afforestation Fund Management and Planning Authority
CBMWTF	-Common Bio-Medical Waste Treatment Facility
Cd	-Cadmium
CD	-Check Dam
CEMS	-Continuous Emission Monitoring System
CETP	-Common Effluent Treatment Plant
CFL	-Compact Fluorescent Lamps
CGWB	-Central Ground Water Board
CH_4	-Methane
CK	-Chal Khal
CO	-Carbon monoxide
CO_2	-Carbon dioxide
CPCB	-Central Pollution Control Board
CPHEEO	-Central Public Health and Environmental Engineering Organisation,
Cr	-Chromium
CSCs	-Community Sanitary Complex
CT	-Contour Trench
Cu	-Copper
DDT	-Di-chloro diphenyltrichloroethane
DPR	-District Project Report
DPRO	-District Panchayati Raj officer
EEE	-Electronics & Electrical Equipment
EEMI	-Electricals & Electronics Manufacturing in India

ENVIS	-Environmental Information System
ETPs	-Effluent Treatment Plants
E-Waste	-Electronic Waste
F	-Fluoride
FPZ	-Flood plain zones
FSI	-Forest Survey of India
FSSM	-Faecal Sludge & Septage Management System
GBPNIHE	-G.B. Pant National Institute of Himalayan Environment
GIS	-Geographical Information System
GPS	-Global Positioning System
HCFs	-Health Care Facilities
HFL	-Highest Flood level
ICIMOD	-International Centre for Integrated Mountain Development
ICT	-Information & Communication Technology
IEC	-Information, Education & Communication
IHHLs	-Individual Household Latrines
IPC	-Inter-Personal Communication
IPCC	-Intergovernmental Panel on Climate Change
IRAP	-Integrated Rural Area Programme
ISO	-International Organization for Standardization
ISWM	-Integrated Solid Waste Management
IWRM	-Integrated Water Resources Management
MBBR	-Moving Bed Biofilm Reactor
MDWS	-Ministry of Drinking Water & Sanitation
MMT	-Million Metric Tons
MoEF&CC	-Ministry of Environment, Forest & Climate Change
MoF	-Ministry of Finance
MoUHA	-Ministry of Urban & Housing Development
MPCC	-Medical Pollution Control Committee
MRF	-Material Recovery Facility
MSMEs	-Micro, Small & Medium Enterprises
MSW	-Municipal Solid Waste
MTPD	-Metric Ton Per Day
NA	-Data Not Available

NA	-Not Applicable
NAAQS	-National Ambient Air Quality Standards
NACP	-National Clean Air Program
NASA	-National Aeronautics & Space Administration
NCEPC	-National Committee on Environment Planning & Co-ordination
NGOs	-Non-Governmental Organizations
NGT	-National Green Tribunal
NH	-National Highway
NITI	-National Institution for Transforming India
NP	-Nagar Panchayat
NPP	-Nagar Palika Parishad
NTFPs	-Non-Timber Forest Products
ODF	-Open Defecation Free
OSS	-On-Site Sanitation
PAT	-Perform, Achieve & Trade
PCC	-Pollution Control Committee
PHCs	-Primary Health Centre
PM	-Particulate Matter
PT	-Percolation Tank
PWD	-Public Works Department
QPD	-Quintal Per Day
RBMs	-Riverbed Minerals
ROHS	-Restriction of Hazardous Substances
RSM	-Rural Sanitary Marts
RTRWH	-Rooftop Rain Water Harvesting
SBM-G	-Swachh Bharat Mission Gramin
SDGs	-Sustainable Developmental Goals
SIDCUL	-State Industrial Development Corporation of Uttarakhand Limited
SLWM	-Solid & Liquid Waste Management
SPCB	-State Pollution Control Board
SSMG	-Sustainable Sand Management Guidelines
STP	-Sewage Treatment Plant
TPD	-Ton Per Day
TSDF	-Treatment Storage & Disposal Facilities

UKPCB	-Uttarakhand Pollution Control Board
ULBs	-Urban Local Bodies
UNDP	-United Nations Development Programme
UREDA	-Uttarakhand Renewable Energy Development Agency
WHO	-World Health Organization
ZED	-Zero Effect Zero Defect
ZLD	-Zero Liquid Discharge
µg	-Microgram

EXECUTIVE SUMMARY

Champawat district is witnessing an unprecedented rise in levels of urbanization, a rising quantity of municipal and other types of waste, waste water and a lack of sustainable public transport. Moreover, increased tourism has brought with it several environmental and urban planning related challenges for the district. While the causal mechanisms of environmental and climate change are numerous and complex, economic growth and population growth are the factors that can be highlighted to explain the increasing stress imposed by human interference on the natural environment.

To analyse the current environmental status and to furnish a comprehensive plan to mitigate the environmental deterioration, GBPNIHE was assigned the task to prepare a district Environment plan. Detailed deliberations were carried out to devise the action plan focusing on explicit thematic areas which include:

- ***Waste Management Operations:*** At present, proper collection and disposal of solid waste *(both dry and wet)* is practised in the urban centres of the district. However, there is no established mechanism for waste collection in rural areas.
- Waste segregation at the source is a major issue in all the urban local bodies of the district. Moreover, the waste recovery and disposal facilities are not robust. Due to improper segregation of municipal solid waste, domestic hazardous and E-waste are also dumped in the landfill sites causing environmental hazards.
- ***Biomedical Waste Management:*** Currently no healthcare facility in the district has linkage with any Common biomedical waste treatment facility of the district. The deep burial method is adopted in all health care facilities for the disposal of biomedical waste. However, Autoclaves are used for the disinfection of the contaminated waste
- So the district authority must consider linking the health care facilities of the district with the nearby common biomedical waste treatment facility.
- ***Construction and demolition waste management:*** Rapid urbanisation and development of road infrastructure *(especially The Char Dham road project)* in the district have led to an increase in the generation of construction and demolition waste. Indiscriminate disposal of road construction and debris from landslides have endangered downhill slopes and polluted rivers. Still, the district lacks a mechanism for the proper handling of this waste. By laws must be framed to have a common set of guidelines for the management of C&D waste.

- ***Waste water Management***: At present, there is no sewage treatment plant in any of the towns of the district. Conventional on-site sanitation method of septic tank+soak pit is mostly used everywhere in the district.
- So there is an urgent need to implement the FSSM (Fecal Sludge and Septage Management) policy of the central government to improve sanitation in the district. As this is both financially and topographically suitable for the district.
- The district has no operational industrial effluent treatment plant as liquid waste generating industrial units are not established in the district so far.
- ***Air and Noise Pollution:*** Compared to a couple of decades ago, particulate pollution is no longer a feature of Indo-Gangetic plains alone. Events of massive forest fires are increasing and the numbers of vehicles are also soaring. Thus there is a need for continuous monitoring of air quality and noise levels in the district to come up with a mitigating strategy.
- ***Surface and Groundwater Management:*** As the global temperatures are rising and weather patterns are changing drastically, the water sources in the Himalayan region are severely affected. As the district is dependent on both glacier and groundwater-fed water bodies and ground water sources for its water needs, hence proper watershed and spring shed management needs to be done for sustainable management of water sources.
- ***Mining activity:*** In recent years, the activities of illegal mining are shown a rise in the district but a robust mechanism is not developed so far to tackle it. Further, with the rapid urbanisation, there is a possibility of an exponential rise in the demand for sand and other RBMs (Riverbed Minerals), so proper surveillance with the help of modern equipment now becomes necessary to have a check on the mining activities within the district.

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

INTRODUCTION

Establishing a link between environmental degradation, poverty and economic sustainability have been always 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 regarding raising a crucial red flag that global temperatures 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, 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 has 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 as a national interest because of working as a guard in view of defense purpose, unique ecosystem in view of permanent snow cover and incessant sources of water and biodiversity hotspots. The people in downhill slopes and in the Indo–Gangetic plains realize its significance in many more aspects in view of sustainable development. A prerequisite for such

sustainability is ecological audit in areas, which at once would apprise about the present environmental issues and a strategy to meet the targets for the future (Sandhu and Sandhu, 2015).

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

The art of establishing balance between economic development and sustainable development is known to many, but how is implemented in the ground is known by 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). A rather unusual situation had arisen in this case had also encroached on protracted forestland after which encroachment was subsequently regularized. Though the Supreme Court did not specifically refer to the Doctrine of Public Trust directly in many cases they have given impact on this doctrine implicitly (Azash and Thirupalu, 2017). Traditionally, the doctrine of public trust was applied only for protection of access to the common for public benefit, now the doctrine is being applied even to prevent over-exploitation of the environmental components (Azash and Thirupalu, 2017).

Public Liability Insurance

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

ENVIRONMENT MANAGEMENT SYSTEM (ISO 14001:2015)

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

DISTRICT PROFILE

The district of Champawat is located in the eastern Kumaon division of Uttarakhand. The district owes its name to King Arjun Deo's daughter Champawati. Earlier this district was a part of district Almora. In 1972 the Champawat tehsil of Almora district was transferred to Pithoragarh. On 15 September 1997 Champawat district was given an independent identity.

It is bounded by Nepal in the east, district Udham Singh Nagar in the south, Nainital district in the west and Almora district in the North West. The district is well connected with the other districts of Uttarakhand with motorable roads. From ancient times Champawat district has had its importance in terms of religious and social aspects. Champawat was the first capital of rulers of the Chand dynasty, they built lots of temples and monuments in Champawat. these monuments are the point of attraction for their brilliant architecture. District Champawat plays an important role from the strategic point of view as it shares an international boundary with Nepal. trading and commerce between Nepal and Champawat take place on daily basis. cross border movement for trade is very common for local people over there.

Table 1. District at a Glance

Geographical Location	
Latitude	$74^0$48'N-$80^0$19'N
Longitude	$28^0$58'E-$29^0$58'E
Geographical Area	1765.78 km^2
Elevation of district headquarters	1615m.
Population Data (2011 census)	
Overall Population	259648
Male Population	291081
Female Population	331425
Population density	147
Population growth rate	15.63%
Literacy rate	79.8%
Male literacy	91.6%
Female literacy	68%
Sex Ratio	980
Administrative Setup	
Tehsils	05
Blocks	04
Nyay Panchayats	24
Village Panchayats	313
Total census villages	632
Municipal councils	02
Nagar panchayats	02

Source: District census handbook 2011 & District statistical report 2019

Topography

Champawat mainly consists of mountain ranges, large valleys, uneven landscapes, broken cliffs, rivers and rivulets. Based on physiographic features, it can be divided into three main regions, first one is the southern Terai area which is plain and important from the agricultural point of view. The second one is the region consists of Shivalik ranges having the varying elevation of 250m to 1200m, it represents a sloping and uneven topographical land consisting of dense forests. The third one is the lesser Himalayan region in the northern part of the district with an average elevation of 1500m. The following table represents the major river systems in the Champawat district.

Table 2. River systems in Champawat district

River system	Origin	Tributaries
Kali River System	Kala Pani springs, (Pithoragarh)	Sarju, Panar, Ladhia and Lohawati

Climate

The climate of the district is very different. The climate here depends on the elevation and exposure to Sun and Wind. In the Terai area, extreme climatic conditions are observed, Summers in the Terai area are very warm and the temperature sometimes reaches over 40^0C while the winters are very chilled and cold wave conditions are observed many times. However, the temperature in the Shivalik and lesser Himalayan region generally remains pleasant throughout the year. Some of the high mountainous areas even receive precipitation in the form of snowfall. The climatic conditions in the terai area are similar to Indo-Gangetic plains. The seasonal rains during the monsoon months are very high.

Rainfall

The district receives an average rainfall of about 1085.62 millimetres, which mainly occurs in the rainy season pertaining to the fact that the 75% of the annual rainfall happens from June to September. July and August are usually the wettest months which accounts for about 70 to 80 per cent of the annual rainfall. Some regions of higher elevation also receive precipitation in the form of snow during the winter season. Winter precipitation is usually derived from Western disturbances.

Groundwater

Groundwater is the primary source of water supply for drinking as well as for irrigation purposes in the district. Groundwater in the major part of the district occurs as localized, disconnected aquifer bodies under favourable geo-hydrological conditions such as channel and alluvial terraces of river valleys, joints, fractures, and fissures of crystalline metasedimentary rocks. The groundwater resource estimation could not be carried out as the area is hilly (with slope >20%) and in the major part aquifers are small, isolated bodies and groundwater abstraction is done mainly through hand pumps and springs with almost negligible discharges. Hence large-scale Groundwater development could not be possible in the Champawat district.

Forests

The district has a variety of vegetation types rich in flora and fauna. Vast exploitation of natural flora is due to increasing human intervention on forest biodiversity both economically and

environmentally over the few decade and dependence on plant products. The zone is covered with dense mixed forests mainly of Sal (*Shorea robusta*), Pangar (*Aesculus indica*), Anwala (*Phyllanthus emblica*), Kandaru *(Morina longifolia*), and Bamboo (*Bambusa vulgaris*) (tropical giant grass). The region is composed of sedimentary deposits. High base status soils are spread over the region. Only one metallic road from Champawat to Tanakpur crosses the region for few kilometres. Most of the areas are remote places.

Table 3. Forest Cover of Champwat District

Particular	**Geographical Area**	**Very Dense Forest**	**Mod. Dense Forest**	**Open Forest**	**Total**	**Change wrt 2017 assessment**
Forest Area of Champawat (Km^2)	1,766	367	593	265.55	1225.55	1.55

Sources: FSI Report 2019

Flora and Fauna

Flora

The Kumaun region, with its scenic beauty and rich floral, faunal wealth has been attracting the nature lovers and researchers (Pant & Samant, 2010). Plants have played an important role in the life support system of human beings from times immemorial. The use of plant species of the Himalayas as medicine has been known for a long time This area falls in the Shivalik hills and lesser Himalayan zone, and is very rich in flowering and non-flowering plants because of varied vegetations, climate, topography, soils, rivers, and valleys, etc. Burans (*Rhododendron arboreum* Sm.), Walnut (*Juglans regia* L.), Jamun (*Syzygium cumini* (L.) Skeels), Behada (*Terminalia bellirica* (Gaertn.) Roxb.), Teak (*Tectona grandis* L.f.), Sal (*Shorea robusta* C.F.Gaertn.), Amaltash (*Cassia fistula* L.), Bail (*Aegle marmelos* (L.) Correa), etc. are important plants species in the Champawat district (Table.

Table 4. Altitudinal Variation of Vegetation

Geographical Region	**Important Species**
Terai Region	Eucalyptus (*Eucalyptus globulus* Labill.), Babool (*Vachellia nilotica* (L.) P.J.H.Hurter & Mabb.), Teak (Tectona grandis L.f.), Haldu (*Adina cordifolia* (Roxb.) Brandis), Sal (*Shorea robusta* C.F.Gaertn.), Bamboo (*Bambusa balcooa* Roxb.), Bail (*Aegle marmelos* (L.) Correa), Madar (*Calotropis gigantea* (L.) W.T.Aiton), etc.

Shivalik and Lesser Himalayan region	Pine (*Pinus roxburghii* Sarg.), Oak (*Quercus leucotrichophora* A.Camus), Burans (*Rhododendron arboreum* Sm.), Walnut (*Juglans regia* L.), Amla (*Phyllanthus emblica* L.), Ayar (*Lyonia ovalifolia* (Wall.) Drude) Tun (*Toona ciliata* M.Roem.) and Khatic (*Celtis australis* L.), etc.

Source: District Survey Report, Champawat

Fauna

A variety of wild animals are found in the Champawat forests region. Around 65% area of the district is covered with flora and fauna and the rest 35% is used s agricultural, grazing and barren land. Besides the hills, the plains are vegetated. The forest of the region is blessed with various kinds of wildlife including Tiger (*Panthera tigris*), Langur (*Semnopithecus entellus*), Monkey (*Macaca spp*.), Kakar (*Muntiacus muntjak*), Cheetal (*Acinonyx jubatus*), Barahsingha (Rucervus duvaucelii), Himalayan black bear (*Euarctos americanus*), Kakar (*Muntiacus*), Ghoral (*Nemorhaedus goral*), deer (*Axis axis*) etc. Various kinds of beautiful birds particularly Sarso, a sovereign bird is found every year during the winter season is the speciality of the region (District Survey Report, Champawat 2018).

Culture and Tradition

Champawat is famous for its ancient temples which have been erected here for years. Some of the sacred shrines of Champawat includes The Baleshwar temples, The Nagnath temples, The Kranteshwar temple, etc. displaying the remarkable architecture of the Chand dynasty. Other sacred places in the district include The Poornagiri temple, The Devidhura temple, The Reetha sahib Gurudwara etc. The people of Champawat have kept their ancient Kumauni culture alive as they still follow the rituals which they used to perform in the 10th century.

MAJOR ENVIRONMENTAL CONCERNS IN CHAMPAWAT

Champawat district has rugged terrain is comprising various landforms from high mountains and deep river valleys in the northern and central part to the plain area in the southern part of the district. So every region has its concerns in terms of environment is concerned. The southern Terai region has groundwater is in abundance whereas in the mountainous region water crises are the primary concern as the level of groundwater is decreasing due to incidents of massive forest fires and the use of dynamite for road construction, causing the reduction in the flow of many rivers at there.

Whereas in the southern Terai area unplanned development in the towns of Tanakpur and Banbasa in recent years caused many problems as the tows are facing the problems of improper drainage and waste management facilities. As the migration from the hilly areas to this region has increased exponentially in recent years so it has created an overload on the resources of this region. Illegal sand mining has also emerged as one of the major concerns over the past few years in this region.

Climate change also has some serious repercussions in this region as the weather patterns are changing and incidents of Cloud Bursts and flash floods have become normal which is affecting the agricultural practices and this is affecting the livelihood of the local people.

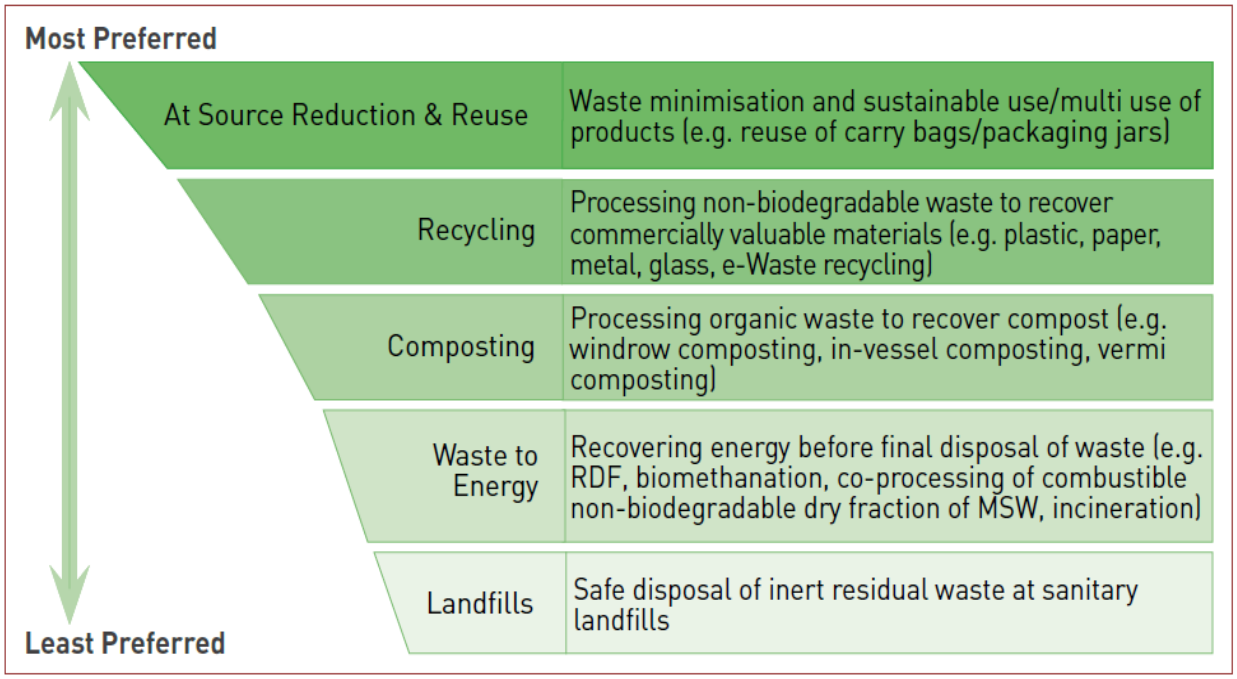
DATA AND IMPACT ANALYSIS

SOLID WASTE MANAGEMENT

MoEF&CC *(Ministry of Environment, Forest and Climate Change)* defines MSW *(Municipal Solid Waste)* 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 *0.67kg* per capita per day in cities. More than *70%* of waste in India is believed to be dumped in an unsatisfactory manner.

Integrated Solid Waste Management (ISWM)

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



Source: Ministry of Urban Development

Fig. 1. Integrated Solid Waste Management (ISWM)

Table 5. Inventory of Total Solid Waste Generation

Name of Urban Local Body	**Population (2011)**	**Number of Wards**	**Solid waste generation *(MTPD)***			
			Dry	Wet	C&D and other waste *(Unsegregated waste)*	Total
Nagar Palika Parishad Tanakpur	21484	11	1.814	1.814	1.36	4.98
Nagar Palika Parishad Champawat	12756	09	1.5	2.0	2.0	5.5
Nagar Panchayat Lohaghat	7932	07	3.5	1.0	0.4	4.9
Nagar Panchayat Banbasa	6023	07	1.5	0.5	0.2	2.2

Table 6. Waste Management Operations

Waste Management Operations	**Outcome**		
Segregation at source	***Complete source Segregation***	***Partial source segregation***	***No source segregation***
	-	• NPP Champawat • NPP Tanakpur • NP Banbasa	NP Lohaghat
Door to Door Collection	All the ULBs in the district have 100% coverage for door to door collection.		
Sweeping	All the ULBs in the district are accomplishing 100% sweeping by manual method.		
Waste Transportation	***Completely Segregated Transport***	***Partially Segregated Transport***	***Combined Transport***
	-	• NPP Tanakpur • NPP Champawat • NP Banbasa • NP Banbasa	NP Lohaghat
MRF *(Material Recovery Facility)* operation	• Currently no ULBs has installed Material recovery facility. • A temporary site is used by all the ULBs for final segregation and further disposal.		
Involvement of Non-Governmental Organizations (NGOs)/ private agencies	• NPP Tanakpur (*KPS Enviro-Tech. Ltd*.) and NP Banbasa (*Public Associates Ltd*.) have hired private agencies to manage their waste management operations. • NPP Champawat and NP Lohaghat are performing waste management operations by themselves.		
Authorization and issuance of Identity cards to waste pickers/Sanitation workers	***ULB***	***Numbers***	
	NPP Tanakpur	75	
	NPP Champawat	45	
	NP Banbasa	24	
	NP Lohaghat	21	
Linkage With Treatment Storage and Disposal Facilities (TSDF) /Bio-Medical Waste Treatment Facility (CBMWTF)	No ULB in the district has linkage with the treatment storage and disposal facility.		

Table 7. Present Infrastructure for Waste Management Operations

Name of ULB	Inventory of infrastructure involved in waste management operation					
	Waste collection trolleys	**Mini collection trucks/tractors/ others**	**Composting units/ On-site composting facilities**	**Material Recovery Facility (Available/Not Available)**	**Landfills (open dumping/Trenching Ground/sanitary landfills)**	**Remarks**
NPP Tanakpur	40	10	06	Not Available	Trenching Ground *(Temporary)*	• DPR of 4.75 cr. has been approved to ramp up the waste management operations in the ULB. • As per the DPR, cluster-based waste management approach will be adopted for Tanakpur and Banbassa.A single recovery facility will serve both the ULBs.
NPP Champawat	50	06	09	Not Available	Trenching Ground (Temporary)	DPR of 4.73 cr. is sent for approval to revamp the waste management operations.
NP Banbasa	10	03	06	Not Available	Open Dumping	Combined DPR is approved for Banbassa and Tanakpur.
NP Lohaghat	21	04	01	Not Available	Trenching Ground	DPR of 83.51 lakhs has been approved to strengthen the waste management operations. Allocated fun will be used to set up a material recovery facility along with required machinery.

Table 8. Methods of Treatment, Disposal and Recovery

Name of ULB	Wet waste management (Centralised or on-site composting)	Dry Waste Management (waste to Energy/Recycling/incineration/ open Dumping in Trenching ground/ sanitary landfill)	Remediation of the old dump site
NPP Tanakpur	Composting of bio-degradable waste is done in the centralised manner at 6 pits by the NPP.	• Municipal waste after collection is transported to the final segregation site where it is further segregated into biodegradable and non-biodegradable waste. • Some of the waste*(plastic waste)* is compacted and sold to local scrap pickers.Left over waste is either recycled or dumped in trenching ground.	Remediation of one old dump site is expected to begin soon *(be after monsoon).*

NPP Champawat	• Vermicomposting of the wet waste is done at the trenching ground. • 9 composting pits are constructed for this purpose.	• Dry waste after final segregation is compacted and stored by the Nagar Palika near the segregation site*(due to unavailability of recycler).* • Some of the dry waste is also sold to local scrap pickers free of cost. • To sell the rest of the compacted waste,Nagar Palika Board is planning to float the tender.	One of the old dump site on the hill slope has been remediated two years ago. Plantation is encouraged in the dump site. .
NP Banbasa	Composting of bio-degradable waste is done in the Centralised manner at 6 pits by the NP.	• Dry waste after final segregation is compacted.A portion of the compacted waste is sold to local rag pickers. • The rest of the compacted waste is stored near the segregation site to sell off to recyclers.	Remediation of the old dumpsite is yet to be started by the Nagar Panchayat.
NP Lohaghat	Composting of wet waste is done near the segregation site of the ULB.	• Dry waste after segregation is compacted and sold to the recyclers in Haldwani by third party intervention. • Residual (Inert) waste is dumped in the trenching ground.	Remediation of legacy waste is yet to begin.

Table 9. Gap Identification

Name of ULB	Observed Shortcomings	Remarks
NPP Tanakpur	*Partial Source segregation of waste*	NPP has achieved 70% source segregation so far and is aiming for 100% segregation at source.
	Partially segregated waste transport	As the waste is partially segregated at source ,hence complete segregated waste transport is not possible as of now.
	Non-availability of any waste recovery facility.	Material recovery facility is under construction in the ULB.
	Remediation of old dumpsite not initiated	Nagar palika is planning to begin the remediation process as early as possible.
	No linkage with authorised waste recyclers	ULB has no linkage with any authorised recyclers to sell recyclable waste.
NPP Champawat	*Partial Source segregation of waste*	Source segregation is practised in only one-third of the households of the ULB.
	Partially segregated waste transport	As the waste is partially segregated at source ,hence complete segregated waste transport is not possible as of now.
	Minimal involvement of NGO/private firm for waste management operations.	No NGO or Private firm is consulted for revamping the waste management operations in the ULB.

	Non-availability of any waste recovery facility	Waste recovery facility has been proposed in the ULB under the DPR approved.
	No linkage with authorised waste recyclers	U.L.B. sells their waste to local rag pickers who are not authorised so far.
NPP Banbasa	*Partial Source segregation of waste*	As of now, partial source segregation is achieved and ULB is trying their best to achieve 100% source segregation.
	Partially segregated waste transport	As the waste is partially segregated at source ,hence complete segregated waste transport is not possible as of now.
	Minimal involvement of NGO/private firm for waste management operations.	No NGO or Private firm is consulted for revamping the waste management operations in the ULB.
	Non-availability of any waste recovery facility.	Construction of material recovery facility is proposed under approved DPR.
	No linkage with authorised waste recyclers.	Because of non-linkage with any recycler ,compacted waste is stored near the dumpsite and could not be monitized.
NP Lohaghat	*No Source segregation of waste*	At present segregation at source is not practised in ULB. A combined collection of dry and wet waste is done.
	Partially segregated waste transport	As the waste is not segregated at source ,hence complete segregated waste transport is not possible as of now
	Non-availability of any waste recovery facility	Waste recovery facility has been proposed in the ULB under the DPR approved.
	Minimal involvement of NGO/private firm for waste management operations.	No NGO or Private firm is consulted for revamping the waste management operations in the ULB.
	No linkage with authorised waste recyclers	ULB sells their waste to unauthorised local rag pickers and hence cannot be a part of formal economy.

**There is a gap identified in the waste management operations of all the ULBs of the district as no ULB have established linkage with Treatment Storage and Disposal Facility (TSDF) and Common Biomedical Waste Treatment Facility (CBMWTF) for the disposal of domestic hazardous waste and municipal sanitary waste respectively.*

Table 10. Proposed Policies and Budget Requirements Put Forward by Different Stakeholders in the District

ULB	Stakeholders Responsible	Proposed Policy	Current status and Achievements
NPP Tanakpur	Nagar Palika	Revamping Solid waste management	• ULB has achieved ODF status and has currently applied for ODF+ status. • ULB is declared bin free city in December 2020. • A new site is under development (*with a budgetary allocation of 4.75 cr*.) to be used as a segregation centre and waste recovery facility.
NPP Champawat	Nagar Palika	Revamping Solid waste management	• ULB has achieved ODF+ status in May 2021 and is now aiming for ODF++ status. • ULB is declared bin free city in February 2020. • Material recovery facility is under development in the ULB with recent budgetary allocations sanctioned undert the approved DPR.
NP Banbasa	Nagar Panchayat	Revamping Solid waste management	• ULB has achieved the ODF+ status recently and is now aiming for ODF++. • ULB is declared bin free city in 2019. • Combined DPR is approved for the Tanakpur-Banbasa cluster to set up a common material recovery and disposal facility.
NP Lohaghat	Nagar Panchayat	Revamping Solid waste management	• ULB is declared bin free city in 2020. • DPR of 1.32 cr. has been approved for ramping up the waste management operations in the ULB.

Vegetation Suitable for Rehabilitation of Dump Sites

Phytoremediation, collectively referring to all plant-based technologies, uses green plants to remediate contaminated soils(Sadowsky, 1999). Natural or planted vegetation on landfill sites has a key role in soil erosion control and removal of contaminants, besides imparting aesthetic value. Moreover, it may be used in leachate treatment. Landfill vegetation often shows signs of damage commonly caused by the presence of landfill gas in the root protection zone. The aim for the reconstruction of a suitable medium for landfill re-vegetation is to provide a deep cover and as

favourable to root growth as is necessary to achieve desired plant performance. (Nagendran, et al. 2006)

Table 11. Vegetation suitable for rehabilitation of dump sites

Botanical Name	Laocal and English Name	Altitude (m)	Life form	References
Tectona grandis L.f.	Teak	1100-1600	Tree	Das, 1981
Ficus palmata Forssk.	Timla	1000-1600	Tree	Das, 1981
Quercus leucotrichophora A. Camus	Banj oak	1200-2200	Tree	Das, 1981
Ficus infectoria Willd.	Fig	1100-1800	Tree	Nagendran, et al. 2006
Bauhinia purpurea L.	Guiral	1250-2000	Tree	Chaphekar, et al., 1980
Acer macrophyllum Pursh.	Maple	1000-1800	Tree	Smith, 1981
Celtis australis L.	Kharik	850-1400	Tree	Meenakshy et al, 1981
Morus alba L.	Shehtoot	1000-1800	Tree	Das, 1981
Debregeasia longifolia (Burm.f.) Wedd.	Tusiyari	1200-2000	Shrub	Das, 1981
Cynodon dactylon (L.) Persoon	Doob, Dubla	500-1650	Herb	Prajapati, 2012
Helianthus annus L.	Sunflower	1000-2200	Herb	Chaphekar, et al., 1980

Projected Population and Waste Generation in Champawat District

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

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

- The arithmetic increase method has been used for the decadal population forecast, hence the rate of change of population with time is assumed to be constant.
- 1.5% yearly growth in per capita waste generation has been taken keeping in mind the changing waste paradigm and floating population *(MOF,2009).*
- While forecasting predicted waste has been mentioned in a suitable range to provide flexibility in deciding waste management operations.
- The analysis includes population and waste generation estimations only for Urban local bodies and does not include areas under peri-urban and rural areas.

Table 12. Estimated Waste Generation

ULB	Projected Population			Projected Waste Generation (MTPD)		
	2021	2031	2041	2021	2031	2041
Tanakpur	27157	32830	38503	4.98	6.92	9.18
Champawat	21553	30350	39147	4.50	7.29	10.63
Lohaghat	10035	12138	14241	4.50	6.26	8.30
Banbasa	7046	8069	9092	2.20	2.90	3.69

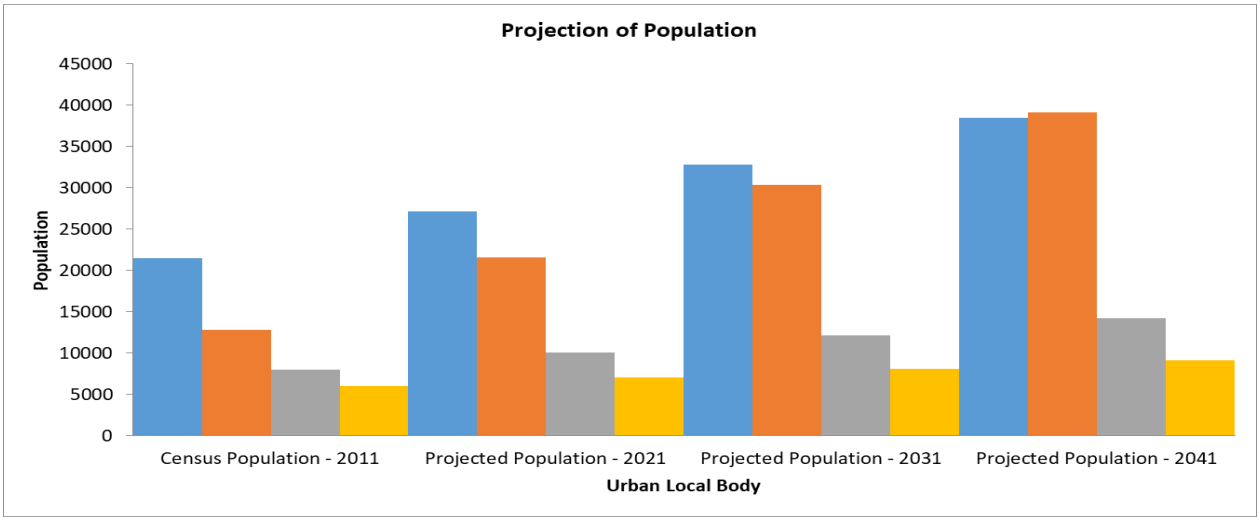


Fig. 2. Graphical Representation of Projected Population

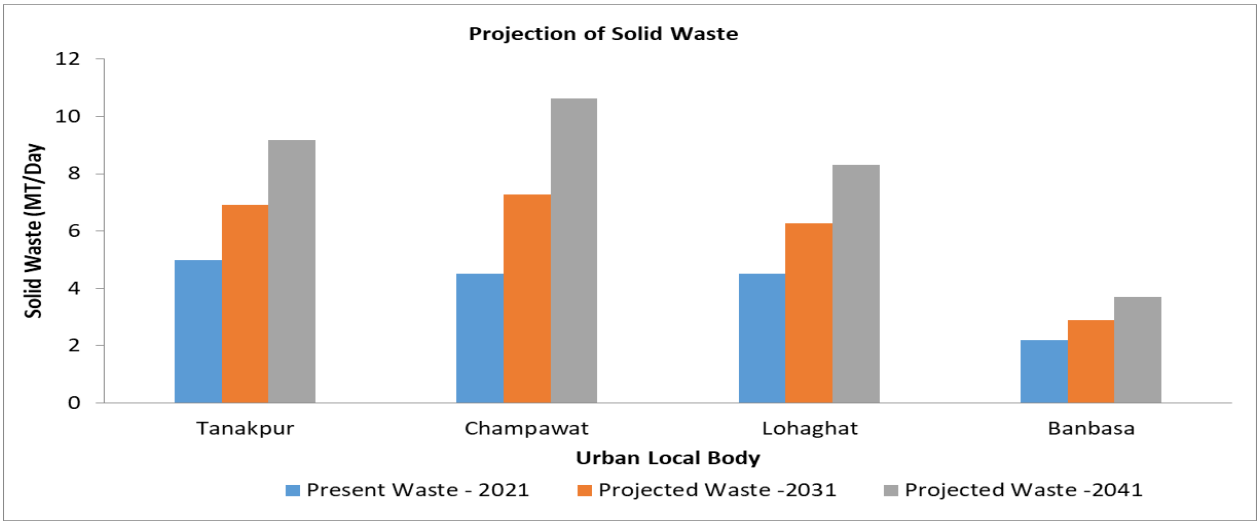


Fig. 3. Graphical Representation of the Projected Solid Waste Generation

Inferences from the Forecasted Data

- All the urban local bodies are showing significant growth in waste generation with time, Hence adequate infrastructure, manpower and machinery will be required in the near furure.

- Among all the urban local bodies Nagar Palika Parishad Champawat is witnessing tremendous population growth and its population is likely to surpass Nagar Palika Parishad Tanakpur by the year 2041 and waste production by 2031.

Rural Solid Waste Management

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

Current standpoints about Rural Waste Management in India

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

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, district level health care facilities (District hospitals, base hospitals, etc.), community health care centres (CHCs), and primary health care centres (PHCs). Due to its typical physiographical conditions and changing density of population during different decades from one area to other, there is a need for biomedical waste management in the state of Uttarakhand. Biomedical waste has shown a wide variation among its 13 districts (Fig.4).

Source: CPCB (Central Pollution Control Board)

Fig. 4. Segregation of Biomedical Waste As Per BMW Rules, 2016

Importance of Biomedical Waste Management in the Wake of Pandemic

The world is facing the crisis of Covid pandemic situation. This situation has increased manifolds in the generation of biomedical waste. Similar trend is 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). In Almora district, the daily biomedical waste generation increased by four times during the peak of the pandemic situation. 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 in the municipal solid waste. It is thus 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.

Table 13. 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	21
		Non-bedded HCFs	66
		Total	87
2.	Miscellaneous Health care Facilities in the District	***Facility***	***Numbers***
		AYUSH wings & Hospitals	21
		Veterinary Hospitals	14
		Pathology Labs	04
		Dental Clinics	03
		Blood Banks	01
		Bio-research labs	-
		Others	-
3.	Number of health care facilities authorised by SPCB/PCC	All Health care facilities are authorised by the state pollution control board.	
4.	Method of Disposal	• Deep burial after proper disinfection by autoclaving or other disinfectants. • Liquid waste generated from healthcare facilities (especially from pathology labs) is discharged after proper disinfection.	
5.	Linkage with Common Bio-medical Waste Treatment Facility (CBMWTF)	At present no health care facility is linked with a Common biomedical waste treatment facility *(No such facility is available within 75 km radius of the district).*	

Disposal of Bio-Medical Waste in the District

- Currently 75 kg biomedical waste is generated monthly in the district which saw a significant rise during the covid times.
- Total 16 autoclaves are operational in the district at all the district and sub district level hospitals and community healthcare centers (CHCs) for disinfection of the infectious biomedical waste.
- Deep burial method is used in all the healthcare facilities of the district for the disposal of the biomedical waste.

Table 14. Current Status of Biomedical Waste Management

S. No.	Action areas	Outcomes
1.	Authorisation of health care facilities by SPCB	All the health care facilities of the district are authorised by the state pollution control board.
2.	Adequacy of facilities to treat biomedical waste	• At present ,treatment of biomedical waste is done with the help of autoclaves and other disinfectants such as sodium hypochlorite and bleaching powder. • The facility of incineration is not available in the district.
3.	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 biomedical waste medical waste management rules ,2016.
4.	Tracking of biomedical waste*(Implementation of bar code system for tracking)*	There is no facility available in the district for the bar code tracking of biomedical waste.
5.	District level monitoring committee	Established under the chairmanship of the District Magistrate.

Table 15. Proposed Policies for Biomedical Waste Treatment in the Department

Proposed Policy	Stakeholder	Remarks
Establishment of Effluent treatment plants in the hospitals generating liquid waste in the district.	Health Department	The proposal is sent to the government and it is subjected to the required environmental clearances.

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. 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 (CPCB, 2020). C&D waste mainly consists of concrete, bricks, sanitary ware, glass, steel, plastic, etc.

Implementation of 3R Principle in C&D Waste Management

Construction and demolition waste is inert in nature. It does not create chemical or biochemical pollution so in view of its management, maximum emphasis should be given on its 4R's principles. Principles of construction and demolition waste refers to refuse, reduce, reuse, and recycle particularly in the direction of sustainable management in urban local bodies (Srinivas, 2007). It is something like using recyclable materials more than once. First step is to refuse to generate alike waste in ULBs. The quantity of waste generated in the construction industry is quite large and much of this waste can be refused and avoided to generate further. Second, if some C&D waste amount is generated even after taking precautions, then it can be reduced after segregation based on different use pattern within the ULBs. Third, a reasonable amount of C&D waste could be reused either at site of bricks, stone slabs, timber, conduits, piping railings, etc. or developing for eco-parks or filling up of either a corner of new road construction sites, or levelling low lying. The last but not least step is to recycle the C&D waste considered fit for recycling. These 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 4R 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. 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 treatent facility is available in the state for processing the C&D waste.
- In hilly districts, ample dumping zones are not established due to which waste is dumped at the river banks.
- As the management of C&D waste is not done in the state, so it is not possible to assess the total amount of waste generated.

Table 17. Current Status Related to C&D Waste Generation

S. No.	Action Areas	Outcomes/Remarks
1.	Quantity of C&D waste generated *(KGPD)*	Not estimated as no collection initiated. However, the quantity is assumed to be minimal.
2.	Collection of C&D waste	None of the ULBs has initiated the collection of C&D waste in the district.
3.	Establishment of Deposition points/Dumping Zones	No dumping zones are established as of now by any of the ULBs. However, dumping zones are established within the district by departments such as Public Works Department (PWD), Rural Works Department (RWD).
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 has linkage with any other common C&D waste treatment facility outside the district.

Table 18. Gap Identification

S. No.	Observed shortcoming	Outcome/Remarks
1.	Quantification of C&D waste.	As the collection of C&D waste is not initiated hence quantification of C&D waste generated in the district is not possible.
2.	Establishment of collection centre /Deposition points/dumping Zones.	Most of the U.L.Bs has not established dedicated deposition points for C&D waste, at present they are using the dumping zones established by the departments such as state PWD.
3.	Implementation of by-laws for C&D waste management.	Due to lack of awareness regarding C&D waste management, it is not properly segregated, hence as of now the process of implementing by-laws for the C&D waste management is not initiated by any of the ULBs within the district.
4.	Lack of strategies for C&D waste management.	Due to a lack of strategies for C&D waste management, dumping of C&D waste is done along the banks of rivers which is hampering the river profile.

C & D Waste Management In Rural Areas

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

HAZARDOUS WASTE MANAGEMENT

Hazardous Waste is such a waste which is characteristic for physical, chemical, biological, reactive, toxic, flammable, explosive or corrosive. Such waste is dangerous and is likely to cause ill health or environmental degradation whether alone or in contact with other wastes or substances. Hazardous waste generating units, quantification of wastes and tabulation of generated waste in India is done by the respective State Pollution Control Boards (SPCBs). Hazardous industrial wastes in India can be categorized broadly into two categories as under:

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

The present State of Affairs

- 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, during about 8.78 million MT hazardous waste during 2019-20 was generated 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)	% age of Total waste
Land-fillable	2.13	24.29%
Incinerable	0.40	4.52%
Recyclable	2.07	23.59%
Utilizable	4.18	47.60%

Table 20.Inventory of Hazardous Waste in the District

S. No.	**Parameter**	**Present status**			
1.	Quantity of Hazardous waste generated in the district (in MT/Annum)	Incinerable	Landfillable	Recyclable/ Reusable	Total
		-	-	0.2	0.2

2.	Number of Hazardous waste generating industries in the district	04

Table 21. Current Status Related to Hazardous Waste Management

S. No.	Action Areas	Outcome and Remarks
1.	No. of captive / common *Treatment storage and disposal facilities* (TSDF) in the district.	Currently, there is no captive or common treatment storage and disposal facility (TSDF) in the district for the treatment of hazardous waste. The hazardous waste generated in the district is sent to TSDFs available outside the district.
2.	Linkage with common TSDF	**(02)** *(Bharat Oil & Waste Management Ltd., Roorkee, Uttarakhand)* *(K. Nandini Refineries, Pilibhit)*
3.	Display board of Hazardous waste generation in front of gates of respective industries	As per the state pollution control board, all the four Hazardous waste generating industries in the district have installed a display board in front of their gates.
4.	Number of ULBs linked with common TSDFs	No ULB in the district is linked with common TSDFs.
5.	Contaminated sites/probably contaminated sites within the district	As per the state pollution control board, there are no contaminated sites identified within the district.
6.	Regulation of industries & facilities generating Hazardous waste	Industries generating hazardous waste are strictly regulated by the state pollution control board.

ELECTRONIC WASTE MANAGEMENT

The Discarded and end-of-life electronics products ranging from computers, equipment used in Information and Communication technology (ICT), home appliances, audio and video products and all of their peripherals are known as Electronic waste(E-waste). 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.

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	**Percentage contribution**
Computer devices	70%
Telecom sector	12%
Medical equipment	7%
Electric equipment	8%
Others	3%

Worldwide Scenario

- Electronics and Electrical Equipment (EEE) are manufactured and disposed of 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 Electronic waste producer in world. City-wise, Mumbai tops the list in producing electronic waste, followed by New Delhi, Bangalore and Chennai.
- The government offices, public and private sector companies generate nearly 75% of e-waste; with the contribution of individual household only being 16%.
- 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.

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 State pollution control board)*	**Uttarakhand**	*16260 MT*
		Champawat	*Not Estimated*
2.	Toll-free number in the district for the citizens to deposit E-waste.	The facility of a toll-free number to deposit E-waste is not initiated in the district.	
3.	Collection centre established by ULBs in the district.	At present, there is no collection centre established by any of the ULBs or the district administration.	
4.	The number of authorized E-waste Recyclers/dismantlers in the state.	**(05)** • *Attero Recycling Pvt. Ltd. Raipur, Bhagwanpur* • *Bharat Oil & Waste Management, Mukhimpur, Laksar* • *Resource E-Waste Solution Pvt. Ltd. Bahadrabad* • *Scarto Metal Recycle Plant, Mewar Khurd, Roorkee* • *Anmol Paryavaran Sarakshan Samiti, Daulatpur Budhwa Shahid, Banjarewala*	
5.	Linkage with any E-waste recycling facility	No ULBs in the district has established linkage with authorised E-waste recycling facility.	
6.	Control over illegal trading or processing of E-waste in the district.	Controlled	

Table 24. Gap Identification

S. No.	Observed Shortcomings	Remarks
1.	Establishment of collection centres & Toll-free number	• Ample amount of E-waste is lying idle in the government offices of the district which cannot be sent for recycling as there is no facility in the district to deposit E-waste. • As there is no facility of Toll-free number to deposit E-waste in the district so all the E-waste generated from the residential areas is mixed with municipal solid waste and thus not treated properly.
2.	Segregation of E-waste by ULBs	As the quantity of E-waste generated is very less so there is no mechanism in the ULBs for segregation.
3.	Linkage of ULBs with authorised recyclers/ Dismantlers	Yet to establish any linkage

WASTEWATER 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.

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 25. Current Scenario Related to STPs (MLD) in Uttarakhand

Number of STPs Installed in Uttarakhand	71
Total Sewage Generation	627
Installed Capacity	448.18
Operational Treatment Capacity	345
Actual Utilization	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)

Table 26. Current Scenario Related to Sewage Management in the District

Urban Local Body	**Estimated Quantity of Sewage Generated (MLD/Day)**
Tanakpur	1.90
Champawat	0.70
Banbassa	0.58
Lohaghat	0.58

Present State of Affairs

Currently, no sewage treatment facility is operational in Champawat district. It relies on the conventional on-site sanitation (OSS) system of septic tank + soak pit for sewage treatment. The urban centres of the district have seen rapid expansion over the years. However, the infrastructure development related to sewage management has been kept in abeyance pertaining to the fact that it is capital intensive and involves complex engineering which takes considerable time that often cannot match the pace of urbanisation.

On-site sanitation facilities of the district are overstressed due to lack of sewerage treatment facilities in the district .Along with rapid urbanisation of the urban centres ,there are many constraints especially the shortage of land for the construction of individual on-site sanitation (OSS) facilities

Several initiatives have been taken by the Government of India to achieve decent sanitation in the urban areas of the country. These initiatives may be broadly classified into:

(i) Programmatic initiatives

(ii) Policy initiatives

Table 27. Major Initiatives by Government of India

Major categories	Major Initiatives	Objectives
Programmatic initiatives	Swachh Bharat Mission – Urban (SBM-U)	To provide access to sanitary toilet facilities to the entire urban population and to eradicate the problem of Open Defecation from the country.
	Atal Mission for Rejuvenation and Urban Transformation (AMRUT)	Creation of basic urban infrastructure including centralized sewerage and septage management.
Policy initiatives	National Urban Sanitation Programme (NUSP), 2008	To transform Urban India into community-driven, totally sanitized, healthy and liveable cities and towns." The specific goals include awareness generation and behaviour change; open defecation free cities; and integrated city-wide sanitation.

	Manual on Sewerage and Sewage Treatment Systems, 2013:	Separate chapters have been allocated for decentralized sewerage systems and onsite sanitation, wherein, the different methods of decentralized sewerage and onsite sanitation systems are discussed in detail.
	National Policy on Faecal Sludge and Septage Management (FSSM), 2017	To set the context, priorities, and direction for, and to facilitate, nationwide implementation of FSSM services in all ULBs such that safe and sustainable sanitation becomes a reality for all.
	Standard Operating Procedure (SOP) for Cleaning of Sewers and Septic Tanks, 2018	The set of procedures to be followed while cleaning the sewers and septic tanks its cleaning frequency and the use of personal protective & cleaning equipment are discussed in detail.

On-Site Sanitation (OSS) vs. Underground Sewerage system

Wherever a sewerage system is available within 30m from the proposed individual household, community or public toilets ,only the superstructure (i.e. toilets) may be constructed under SBM and connected to the existing sewerage system. No construction of treatment units such as twin pits, septic tank, bio-digester or bio- tank shall be allowed.

But in case no such sewerage network is available then On-site sanitation is the only option left. In this system sewage is collected, treated and/or disposed off at, or near the point of generation, without the use of an underground sewerage system.OSS systems are sanitation facilities provided for the use of individual households, community and the floating population There are a number of situations when an underground sewerage system may not be feasible or desirable. For example, for smaller cities where construction of sewerage infrastructure may be expensive, or those cities that are in hilly areas or in undulating terrain where it may not be practical to construct a sewer network, or even in many cities that have grown organically and where all households are not connected to the existing sewerage network.

Liquid Waste Management in Rural Areas

Since the water supply for domestic purposes in rural areas has improved considerably over the years, the quantity of wastewater that is disposed of has also increased. Hence effective wastewater management systems need to be introduced in the rural areas to mitigate the problem of contamination in the majority of rural areas, untreated wastewater is discharged directly into the

local surroundings and water bodies. This leads to contamination of surface as well as sub-surface water, having negative effects on the environment and human health.

Current standpoint about Rural Wastewater 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 28.Policies Undertaken for WasteWater Management in Rural India

Current Policy	Sponsoring agency	Remarks
Construction and Usage of IHHLs *(Individual Household Latrines)*	Under SBM-G *(Swachh Bharat Mission- Gramin)*	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 SBM-G*(Swachh Bharat Mission- Gramin)*	To provide material, services and guidance needed for constructing different types of latrines and other sanitary facilities for a clean environment,
Community Sanitary Complex (CSCs)	Under SBM-G *(Swachh Bharat Mission- Gramin)*	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.)*
Financial Assistance	Under SBM-G *(Swachh Bharat Mission- Gramin)*	Up to Rs.12000 is provided to BPL *(below poverty line*) households and identified APL *(Above poverty line)* households for the construction of one unit of IHHL. It is not the cost of the toilet but an incentive amount.
Mensural Health Management	Under SBM-G *(Swachh Bharat Mission-Gramin)*	It is aimed at making the behavioural change in the woman and adolescent 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.

GROUNDWATER 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).*

Groundwater 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 a rapid rate and it will very harmful for the mankind

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

Table 29. Water Resources in the District

S. No.	Water Resource	Remarks				
1.	Rivers/Streams in the District	***Name***		***Origin***	***Length in the district (Km.)***	
		Ladhiya			43.5	
		Panar			18.5	
		Saryu			3.5	
		Eastern Ramganga			17.5	
		Kali			48.5	
		Sharda			16.5	
2.	Lakes and ponds	**Name**	**Latitude**	**Longitude**	**Elevation (m)**	**Area (Hectare)**
		Banbasa Barrage	28.99N	80.10E	226	66
		Sharda Barrage	29.05N	80.11E	275	184
		Shyamla Tal	29.15N	80.12E	1316	3.34

Table 30. Pollution Control in Water Resources

S. No.	Parameter	Current Status
1.	Open Defecation in River/Nala/Khad	Controlled
2.	Dumping of solid waste on River Banks	Controlled
3.	Control Measures for idol immersion	No measures taken
4.	Disposal of Untreated Sewage in Rivers	Controlled
5.	Monitoring of Action Plans for rejuvenation of rivers	Monitored
6.	Encroachment near flood plains	Found in the Terai region of the district.
7.	Protection of flood plains	No measures taken

Table 31. Information on Groundwater in District

S. No.	Parameter	Current Status
1.	Groundwater polluted area in the district	None
2.	Adequacy of Groundwater Availability	Adequate in the river valleys but inadequate on hill slopes.
3.	Disposal of Untreated Sewage in Rivers	Sewage is not directly discharged into water bodies.
4.	Access to surface water and groundwater quality data at DM office	Data is not available.

Current standpoint regarding Water Resources Management in Champawat

Present state of affairs

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

- *Deep Tube-well,*
- *Khadins / Nadins/ Tankas/ Ponds / Wells/ Ooranis,*
- *Infiltration well,*
- *Rivers*
- *Rivulet / Naula / Gadhera,*
- *Springs*
- *Treated Surface Water,*
- *Streams*

- Rivulet / Naula / Gadhera (79.5%) followed by Springs (8%) and Streams (6%) are noted to be highly tapped for water schemes in Champawat.
- 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.

Source- Technical report: Water at a glance, Uttarakhand (An Assessment of water scarcity), GBPNIHE

Artificial Recharge of Groundwater

The geographical area of the district is divided into units like Structural hills, Denudational hills, dissected fans, River terraces and flood plains. The southern boundary of the foothills of Himalaya is covered by Bhabar and Terai Gravels and Alluvium. The major part of the hilly area has a slope of more than 20%. A slope of the magnitude of this order makes the area unsuitable for groundwater development due to low groundwater potential. In this region, the groundwater mainly manifests in the form of springs and occurs under unconfined conditions and the water table follows the topography.

Table 32. Artificial Recharge of Groundwater

District	Area (km^2)	Area identified for AR (Artificial recharge) (km^2)	Volume of unsaturated zone (MCM)	Available sub-surface space for AR (MCM)	Water required for artificial recharge (MCM)	Surplus available for recharge (MCM)
Champawat	1766	501	1002	150	200	1253

The major part of the district is hilly with localized small valleys through which the entire runoff passes. The major part of the rainfall is lost as surface runoff. Apart from this the small rivers, nallas also act as carriers for base flow & spring water. Despite good rainfall, there is an acute shortage of water, especially during the summer. The state government is working for rainwater harvesting in the state under many projects to solve this issue.

Table 33. Artificial Recharge and RTRWH Structure constructed in Uttarakhand under catchment area conservation Program (CACMP)

District Name	**Number of structures**					**Total cost (in lakhs)**					**Total cost (in lakhs)**
	CD	CK	RTRWH	PT	CT	CD	CK	RTRWH	PT	CT	
Champawat	90	25	44	13	1675	9	0.75	15.4	0.26	1.68	27.09

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

Table 34. Artificial recharge and cost Estimate in the district

District Name	**Structures proposed**					**Unit cost Estimate (in lakhs)**					**Total cost (in lakhs)**					**Total cost (in lakhs)**
	RTRWH	CD	PT	CK	CT	RTRWH	CD	PT	CK	CT	RTRWH	CD	PT	CK	CT	
Champawat	200	150	40	100	200	0.5	0.3	.07	0.15	.015	100	45	2.8	15	3	165.8

CT-Contour Trench, CK- Chal Khal, RTRWH- Rooftop Rain Water 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 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 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 include 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 PM2.5 and PM10 concentration by 2024 is proposed under the NCAP taking 2017 as the base year for the comparison of concentration.

Table 35. 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 (SO_2), µg/m^3	Annual* 24 hours**	50 80	20 80
Nitrogen Dioxide (NO_2), 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 (O_3) µg/m^3	8 hours* 1 hour**	100 180	100 180
Lead (Pb) µg/m	Annual*	0.50	0.50

	24 hours**	1.0	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/m3	Annual*	1	1
Arsenic(As), ng/m3	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

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

Table 36. 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 37. 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 a non-attainment city according to the national clean air program *(NCAP).*
Prominent sources of air pollution in the district	Unprecedented forest fires and vehicular pollution are major reasons for Air pollution in the district.

Table 38. Control Measures for Industrial / Non-Industrial Air Pollution

Action Areas	Outcomes
Identification of Prominent air polluting sources.	Forest fires are the only prominent source identified.
Control of industrial air pollution	There are very few industrial units in the district. So industrial pollution is not an issue in the district.
Control of non-industrial air pollution	
(a) Control open burning of waste	As almost 100% door to door collection is done in all the ULBs of the district so practices of open burning of waste is not observed. However due to lack of waste collection mechanism,instances of open burning have been observed in rural areas of the district.but in the rural areas where there is no mechanism of waste collection as of now, so waste burning is usually practised there.
(b) Control of forest fires	• Village committees have been formed for surveillance. • Fire watchers are deployed by the forest department. • Personal safety equipment has been provided to the forest guards and other field staff. • Although many steps have been taken but much more needs to be done to control the situation.
(c) Control of vehicular pollution	• 06 PUC (*Pollution Under Control*) centres are operational in the Chamapawat district. • 106 challans have been done so far in the year 2021-22 for violating vehicular pollution norms in the district. • District administration is promoting green mobility under which 538 E-Rickshaws and 6 E-Carts are registered so far.
District level action plan for air pollution	At present, no such action plan has been prepared.
Awareness of air Quality	There is the mindset in the district that air pollution is not an issue in the hilly region so local citizens are not aware of the problem of increasing levels of air pollutants in the district especially in the urban centres of the district.
Development of Air pollution complaint redressal system	Not Initiated

Table 39.Gap Identification

Area of Concern	Remarks
Forest Fires	• Lack of staff • Multiple departments are involved to resolve the issue, hence lack of coordination and responsibility-sharing has been observed. • Sloping terrain makes it difficult for fire tenders to reach high altitudinal areas. • Abrupt migration from villages and change in living habits has exaggerated the situation. • Lack of inspection in forest areas under Van panchayat and Civil Forest.
Lack of monitoring	As no air pollution monitoring stations are installed in the district so the actual status of the ambient air quality is not known.

Noise Pollution Management

Regular exposure to elevated sound levels 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 but exposure to noise levels beyond 85 dB constantly for more than 8 hrs. may be hazardous and lead to loss of hearing. Although noise pollution is not a big issue in the district ,proper monitoring is required to maintain noise levels within the desirable limits. The following table represents the permissible noise level standards in India.

Table 40.Noise Pollution Management in India

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. Daytime 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. A 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.

Noise Pollution Management

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 recieved
3.	Implementation of ambient noise standards in residential and silent zones.	The local police are responsible for the implementation of the ambient noise level standards.
4.	Silent Zones in the district	No place in the district is declared a silent zones.
5.	Setting up of Sign Boards	Signboards are installed around hospitals, schools and along the highways by the concerned authorities.

ILLEGAL SAND MINING

GUIDELINES TO MONITOR SAND MINING IN INDIA

The Mines and Minerals (Development and Regulation) Act, 1957 has empowered state governments to make rules to prevent illegal mining, transportation and storage of minerals. However, still, large 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, Forests and Climate Change (MoEFCC) has put forward the sustainable sand management guidelines (SSMG) 2016, which focus on 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, a new set of guidelines have been put forward by the Ministry of Environment, Forests and Climate Change (MoEFCC) in 2020, which focuses on the effective monitoring of sand mining (from the identification of sand mineral sources to its dispatch and end-use by consumers and the 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 RBM (Riverbed Minerals) 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.

Table 42. Current Standpoints Regarding Mining Activities in the district Prevalent Mining Activities

Parameter	**Outcome**
Total Area of District (km^2)	1766 km^2
Area Covered under Mining (km^2)	3.87 km^2
Type of Mining Activity	River Sand Mining
Sand Mining activity observed in the District	Sand mining operations are widespread in the riverbed .
The area affected by illegal sand mining in the district	None
Number of Mining Licenses given by the District Authority	03

Table 43. Compliance to Environmental Standards

Parameter	**Outcome**
Mining areas meeting Environmental Clearance Conditions	03
Mining areas meeting consent conditions of UKPCB	03
Mining operations suspended for violations of environmental norms	Nil
Pollutions related complaints against Mining operations in past one year	Nil

REJUVENATION OF WATER BODIES

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

Table 44. Present Scenario in the District

The techniques used in the district for rejuvenated 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* • *Plantation drives*
Plant Species used for rejuvenation of water bodies	• *Banj (Quercus leucotrichophora)* • *Bhimal (Grewia optiva)* • *Utis (Alnus nepalensis)* • *Burans (Rhododendron arboretum)*
Local action plan for rejuvenation of water bodies	Traditional water bodies are undergoing restoration within the district under MNREGA with the construction of various water harvesting structures such as Chal- Khals, Check Dams, Ponds and periodic plantation drives.

Gandak River Rejuvenation Project

Gandak river passes through the district headquarters flows in the west to north direction. Since the river passes through the highly populated region of the Nagar Palika Parishad Champawat and nearby peri-urban areas ,it is proe to contamination.Moreover the river is groundwater fed, so the level of the water in the river has also decreased over the years. Given this, thr restoration of the river was started three years back. Forest division Champawat also organizes periodic plantation drives and other restoration activities in the catchment of the year. Last year Irrigation Department Champawat was nominated as the Nodal agency to deal with the environmental and engineering aspects of the catchment of the river.

Gandak River: Overview

- Origin: Cheerapani
- Location of origin:

Latitude $29^0 16'60"$
Longitude $80^0 05'35"$
Altitude *1807.86m*

- Length of the river: 7 Km
- Confluence: Lohawati River

Works Carried Out Under this Project

Following works have been undertaken in the year 2020-21 under Compensatory Afforestation Fund Management and Planning Authority) (CAMPA) fund for the rejuvenation of the Gandak river.

Table 45. The Rejuvenation of the Gandak River by By CAMPA Project

S. No.	Work	Quantity
1.	Check Dam Construction	60 Nos.
2.	Chal-Khal Construction	100 Nos.
3.	Soil development work	15 hectare

Apart from these,various other works such as plantation on 15-hectare land etc. are also proposed in the year 2021-22 for several rejuvenation works.

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 wildlife and Humans. The ongoing pandemic has caused rapid growth in the generation of Plastic waste for the medical, packaging and other services *(like PPE kit, gloves, face shield, packaged food etc.).* Its broad range of applications is in packaging films, wrapping materials, shopping and garbage bags, fluid containers, clothing, toys, household and industrial products, and building materials.

Plastic products have become an integral part of 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 of this is recycled due to the lack of a functioning solid waste management system. This leads to a burden on the landfills and poor socio-economic conditions of the waste pickers, mostly women *(UNDP, 2018-2024).*

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

Plastic Waste Management

Table 46. Inventory of Plastic Waste Generation

Name of Urban Local Body	Population (2011 census)	Number of Wards	Estimated Quantity of Plastic Waste Generated (MT/Day)
Nagar Palika Parishad Tanakpur	21484	11	0.20
Nagar Palika Parishad Champawat	12756	09	0.25
Nagar Panchayat Banbasa	6023	07	0.10
Nagar Panchayat Lohaghat	7932	07	0.10

Table 47. Plastic Waste Management Operations

Waste Management Operations	Outcome	
Door to Door Collection	Almost all the U.L.Bs. have 100% door to door collection in the district.	
Segregated Waste Collection (single used plastic, Recyclable plastic, etc.)	***ULB***	***Segregation***
	NPP Tanakpur	Partial
	NPP Champawat	Partial
	NP Banbasa	Partial

	NP Lohaghat	Not Started
Material Recovery Facility (MRF) operation	No ULB of the district has a functional Material recovery Facility.	
Linkage with Public Relation Officers (PROs) of producers	No ULB in the district has linkage with Public Relation Officers (PROs) of producers.	
Involvement of Non-Governmental Organizations (NGOs)/ private agencies	• Private firms are assisting NPP Tanakpur (*KPS Envirotech limited*) and NP Banbasa (Public Associates limited). • Other ULBs manage their waste management operations by themselves.	
Authorization and issuance of Identity cards to Waste Pickers/Sanitation workers	***ULB***	***Numbers***
	NPP Tanakpur	75
	NPP Champawat	45
	NP Banbasa	24
	NP Lohaghat	21

Table 48.Present Infrastructure for Plastic Waste Management Operations

Name of ULB	**Inventory Of Infrastructure Available For Plastic Waste Management Operation**				
	Plastic Waste collection centres	**Plastic Compactors and its Capacity**	**Linkage with Plastic waste Recyclers**	**Material Recovery Facility (Available /Not Available)**	**Remarks**
NPP Tanakpur	15	01	Plastic waste is sold to local rag pickers	Not Available	• As the city is declared bin free so all the 15 bins are of capacity less than 50 kg. • DPR is approved for the construction of a material recovery facility.
NPP Champawat	60	01	Plastic waste is sold to local rag pickers	Not Available	• As the city is declared bin free so all the 15 bins are of capacity less than 50 kg. • Material recovery facility is under construction
NP Banbasa	Nagar panchayat has removed all the bins from Nagar panchayat to deposit waste, separate bins are provided for dry and wet waste both	01	Plastic waste is sold to local rag pickers	Not Available	• As the city is declared bin free so all the 15 bins are of capacity less than 50 kg. • DPR is approved for the construction of a

	in residential and commercial areas.				combined material recovery facility for Banbasa and Tanakpur.
NP Lohaghat	15	01	Plastic waste is sold to the recyclers available at Haldwani (Nainital).	Not Available	• As the city is declared bin free so all the 15 bins are of capacity less than 50 kg. • DPR is approved for the construction of a material recovery facility.

Projected Population And Plastic Waste Generation In Champawat District

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

Forecasting waste quantities in the future is as difficult as it is in predicting changes in waste composition. As a general rule, the lower the level of economic development, the greater the change between generation and disposal.

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

- The arithmetic increase method has been used for the decadal population forecast, hence the rate of change of population with time is assumed to be constant.
- The per capita consumption of plastic waste has been taken as 11kg/annum. *(Centre for Science and Environment,2019).*
- It is considered that 70% of total plastic waste consumption is discarded as waste. *(CPCB,2013)*
- 16 % yearly growth in per capita plastic waste consumption has been taken keeping in mind the changing waste paradigm and floating population. *(Centre for Science and Environment,2019)*
- The analysis includes population and waste generation estimations only for Urban local bodies and does not include areas under peri-urban and rural areas.

Table 49. Estimated PLastic Waste Generation

ULB	Projected Population			Projected Waste Generation (MTPD)		
	2021	2031	2041	2021	2031	2041
Tanakpur		32830	38503		0.63	1.19
Champawat		30350	39147		0.92	1.91
Lohaghat		12138	14241		0.31	0.60
Banbasa		8069	9092		0.30	0.54

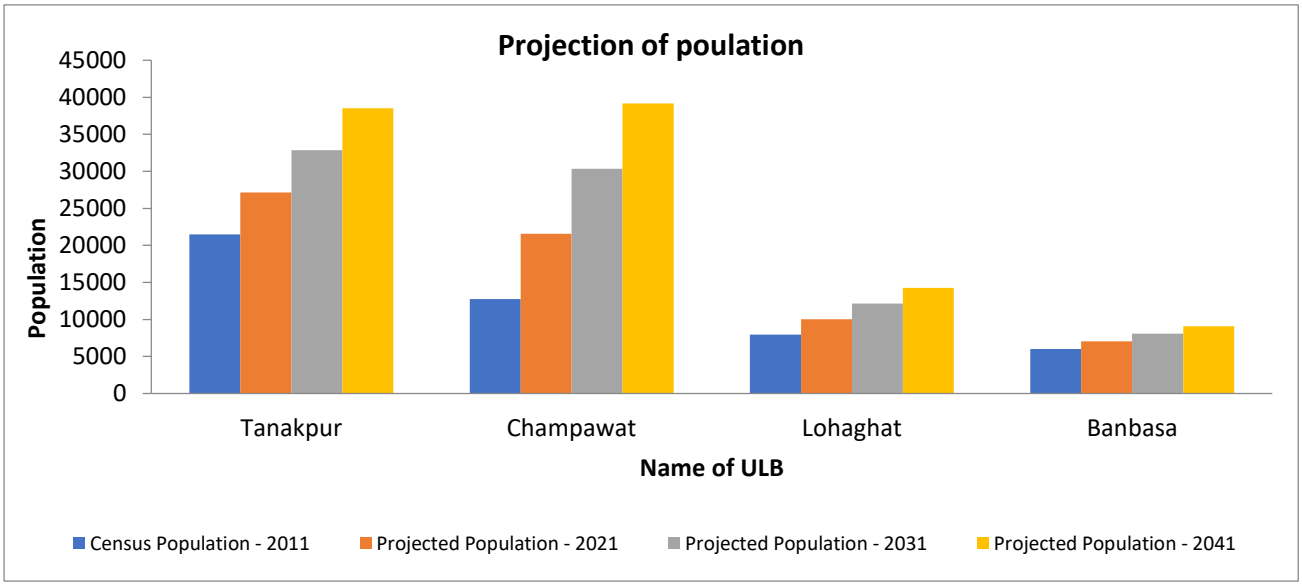


Fig. 5. Graphical Representation of the Projected Population

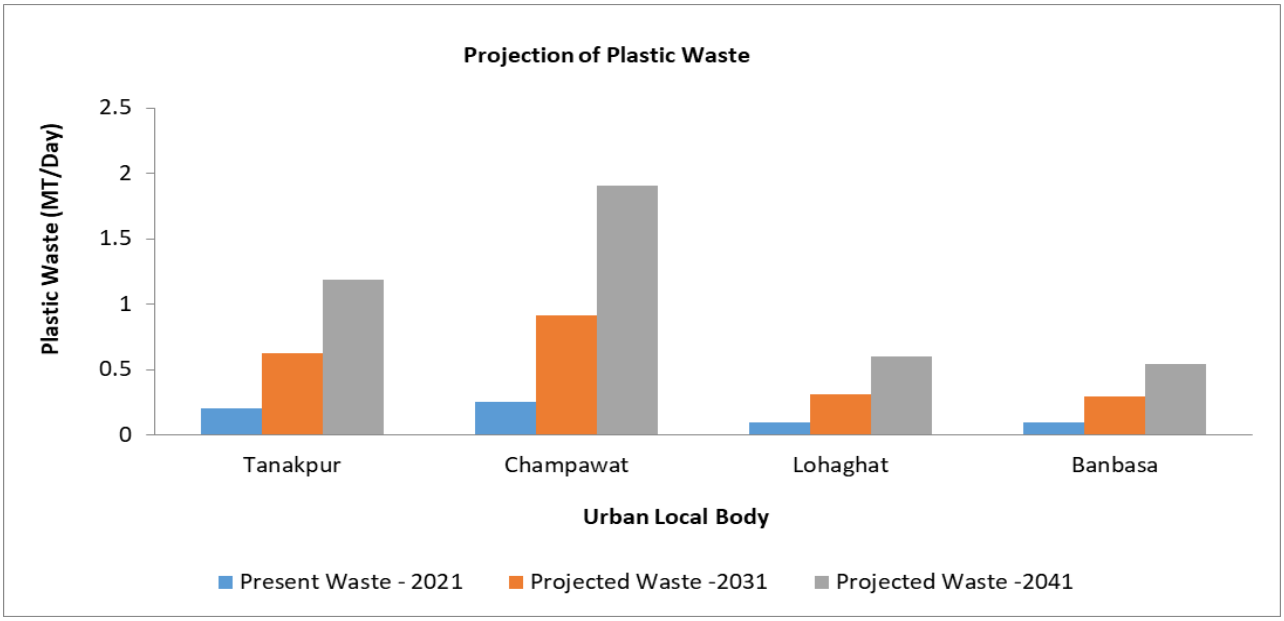


Fig. 6. Graphical Representation of Projected Plastic Waste Generation

ASSESSMENT OF URBAN LOCAL BODIES

Table 50.Assessment of Urban Local Bodies in Champawat District

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

Enforcement of Bye-laws and Waste Management Rules, 2016	**2**	2	1	1	1
Total	**30**	**15**	**13**	**12**	**11**

Table 51. Final Assessment of Urban Local bodies of Champawat District

Name of ULB	Score (out of 30)	Score Percentage(%)
NPP Tanakpur	15	50.00
NPP Champawat	13	43.33
NP Banbasa	12	40;00
NP Lohaghat	11	36.66

Observations from data assessment

- All the ULBs of the district needs improvement in overall waste management operations.
- Overall Nagar Palika Parishad Tanakpur is performing well among all the ULBs.
- Only Nagar Panchayat Lohaghat has established linkage with authorised recyclers .Other ULBs needs to work on it.
- All the ULBs needs to focus on waste processing and disposal as none of them has operational material recovery facilities and sanitary landfills.
- None of the Urban Local Bodies has linkage with CBWTF (Common Biomedical Waste Treatment Facility) and TSDF (Treatment Storage and Disposal facility) for the disposal of municipal sanitary waste and domestic hazardous waste respectively.
- Almost all ULBS lacks on implementing source segregation of waste which requires regular IEC *(Information, Education, Communication)* activities and awareness programs to sensitize the people about the importance of segregating the waste at source.

ACTION PLAN

Table 52. Action Plan for Solid Waste Management

Action Point	Concerning ULB	Strategy/Approach	Stakeholder Responsible	Purpose
Primary Segregation (Segregation at Source)	All ULBs	• Separate Storage Bins. • Regular awareness campaigns. • Man power Management. • Behavioural change Communication techniques. • Promoting Home composting for wet Waste.	• Nagar Palika Parishads/ Nagar Panchayats • Residents and NGOs	• Higher Recovery of Recyclables. • Hygienic environment for handling of waste.
Segregated Waste Transport	All ULBs	Optimizing Waste Management Infrastructure (Collection trucks, trolleys).	Nagar Palika / Nagar Panchayat	• To reduce open dumping of waste. • Man power optimization at the Recovery facility. • Reduction of transportation charges.
Linkage with Treatment Storage and Disposal Facility (TSDF) and Common Biomedical Waste Treatment Facility (CBMWTF)	All ULBs	• Separate bins for sanitary and domestic hazardous waste. • Setting up a common storage facility in the district from where waste can be lifted by a common treatment facility.	Nagar Palika parishad/ Nagar Panchayat	Segregation and proper disposal of Municipal sanitary waste and domestic hazardous waste.
Landfill mining	All ULBs	Converting bio-waste from landfill site into compost while plastic, glass etc., can be used for recycling.	Nagar Palika parishad/ Nagar Panchayat	• To mitigate the environmental impact of waste. (Methane emission) • Resource Recovery of excavated waste.
Scientific disposal of waste	All ULBs	Material recovery facilities and sanitary landfills must be established in the ULBs	Nagar Palika parishad/ Nagar Panchayat State Government	• To eliminate the risk of waste seeping underground (Leachate) within the landfill. • To reduce open dumping of waste.

				• To reduce the possible hazards due to contamination of the ambient environment. • Reduction of Historical waste
Characterisation of waste	All ULBs	• By periodically checking and measuring the waste volume to establish the baseline for the waste generation. • Continuous sampling can be done from various transfer stations and landfill sites to study the nature of municipal solid waste.	Nagar Palika parishad/ Nagar Panchayat	• To adopt proper treatment methods for disposal waste as per its characteristics. • To estimate the daily and seasonal variations in waste generation
Linkage with authorised recyclers	All ULBs	Either the local scrap pickers can be authorised or direct linkage could be established with any recycling unit.	Nagar Palika parishad/ Nagar Panchayat	• To insure proper recycling of the waste. • Reduction of Historical waste.
Cluster-based Approach to Solid waste management	All ULBs	By merging schemes from Central and state government department with Rurban Mission of Ministry of Rural development	District Administration District Panchayati Raj Officer (DPRO)	• To club the villages in peri-urban areas of the town with the nearby solid waste management facility for effective waste management in rural areas. • To execute the Rurban mission of the Government of India.
Community participation for waste management	All ULBs	• Information, Education and Communication (IEC) activities in Educational institutions. • Inter-personal communication (IPC): School children and Sanitation workers to spread awareness	District Administration	• Social and Behavioural Change Communication • Cleanliness drive campaigns throughout the district

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

Phytoremediation as a Mitigation Measure *(For Treatment of Solid Waste)*

Natural or planted vegetation on landfills has an important role in erosion control and removal of contaminants, beside imparting aesthetic value. Moreover, it may also be used in leachate treatment. Phytoremediation is a promising, plant-based technology in which the plants and their associated microbes are utilized to absorb and clean up environmental contamination through engineered constructed systems. The ultimate aim is to either remove the pollutant from the contaminated media or to alter the chemical and physical nature of the contaminant so that it eliminates the risk to human health and the environment. Several plants are being identified to be used in the phytoremediation task.

Table 53. Phytoremediation as a mitigation measures

Botanical Name	Local and English Name	Life form	Assimilating capacity	Altitude (m)	References
Quercus leucotrichophora A. Camus	Banj oak	Tree	Microbial biodegradation, binding, holding soils, and/or decreased leaching	1200-2400	Meenakshy et al, 1981
Bauhinia variegata L.	Kachnar	Tree	Absorbs Zn, Hg, As, Pb, Cu and Cd from wastewater	1250-1800	Das, 1981
Bauhinia acuminata L	Kachnar	Tree	conversion of Hg to volatile chemical from groundwater	1150-1500	Chaphekar, et al., 1980
Adina cordifolia (Roxb.) Hook. f. ex Brandis	Haldu	Tree	conversion of Se and Hg to volatile chemical from groundwater	Upto-1500	Prajapati, 2012
Berberis aristata DC.	Kingore	Shrub	Metals, radionuclides, hydrophobic organics	1350-2000	Das, 1981
Berberis asiatica Roxb. ex DC.	Kilmora	Shrub	Adsorb' all the dissolved gases	1650-2400	Das, 1981
Cynodon dactylon (L.) Persoon	Dubla, Doob	Herb	Absorbs Arsenic and Fluoride from wastewater	700-2500	Chaphekar, et al., 1980

Azolla pinnata R. Br.	Azolla	Herb	Control the Hg, and Cd from wastewater also known as bio-fertilizer	400-2200	Rai, 2008

Table 54. Policies Undertaken for Rural Waste Management in India

Current Policy	Sponsoring agency	Remarks
Decentralized Waste Management	Under SBM-G (Swachh Bharat Mission-Gramin)	Decentralized systems such as household compost and biogas plants shall be encouraged.
Community Sanitary Complex (CSCs)	Under SBM-G (Swachh Bharat Mission- Gramin)	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 the 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.

Table 55. Action Plan for Bio-Medical Waste

Action Areas	Purpose	Stakeholders
Governance		
Periodic inspection of HCFs (Health-care Facilities) by Uttarakhand state Pollution control board (UKPCB).	To ensure proper segregation of Biomedical waste as per Biomedical waste management rules, 2016.	Uttarakhand Pollution control board (UKPCB)
Linkage of District level hospitals and CHCs Community Health Centres with Common Biomedical waste treatment facility (CBWTF)	To ensure proper disposal of Biomedical waste as specified under Biomedical waste management rules, 2016.	Health Department
Linkage of ULBs with Common Biomedical waste treatment facility (CBWTF)	To ensure segregation of Biomedical waste from Municipal solid waste and thus its proper disposal as per Biomedical waste management rules, 2016.	All ULBs
Implementation of Kayakalp initiative	To promote cleanliness, hygiene and infection control practices in public healthcare facilities.	Health Department
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 healthcare facilities) • Training on Biomedical Waste Management Information System (BMWMIS) to all data entry operators and pharmacists.	To keep records of biomedical waste generated in every HCF of the district (especially in PHCs in rural areas).	Health department
Immunisation *(Tetanus and complete doses of Hepatitis-B)* of all hospital	To avoid any kind of infection while handling Biomedical waste.	Health department

staff involved in Biomedical waste management.		
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
Colour coding of bed sheets on specified days.	To ensure infection control and prevent the reuse of linen.	Health department
Timely replacement of bags, BMW transfer to collection shed and then prompt lifting to biomedical waste treatment facility from the shed.	To ensure timely disposal of biomedical waste.	Health Department and Uttarakhand Pollution control board (UKPCB)
Bar code system for tracking bags and containers and use of GPS enabled systems in vehicles.	To ensure tracking of biomedical waste collection, transportation, disposal and recycling as specified under Biomedical waste management rules,2016.	Health Department and Uttarakhand Pollution control board (UKPCB)
Information		
Development of an IT-enabled data management system to keep an inventory of the 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 the primary level.	Health Department
Display details of authorisation, treatment, annual report of all HCFs*(Health-care facilities)* on the website.	To make the information open-source and ensure transparency.	Health Department and Uttarakhand Pollution control board (UKPCB)

Table 56. 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 and nearby villages. • Proper collection and transportation systems should be set up to aid processing. • Illegal dumping practices must be discouraged by charging penalties. • Establishment of dumping zones along district & village roads.	• All ULBs and District Panchayati Raj officer (DPRO) • 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 the C&D waste management rule for proper disposal of C&D waste in the district. • The 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 the river or the hill slopes.	• All ULBs and District Panchayati Raj officer (DPRO) • Public Works Department (PWD)
Management of C&D waste.	To ensure that C&D waste comes to the recycling plants as segregated input, and the recycled products are picked up for use in construction.	• Managing C&D waste separately from municipal solid waste. • Enhancing awareness and incentivization for efficient C&D waste handling and processing.	• All ULBs and District Panchayati Raj officer (DPRO) • Public Works Department (PWD)
Plantation in old dump sites.	Stabilisation of the slope at old dumping zones.	Plantation at the old dumping zone should be done with the help of community participation to stabilize the slope over there.	• All ULBs and District Panchayati Raj officer (DPRO) • Public Works Department (PWD)

Table 57. Action Plan for Hazardous Waste

Action Point	**Purpose**	**Strategy/Approach**	**Stakeholder Responsible**
Linkage of ULBs with common TSDF (Treatment, Storage and Disposal Facilities) 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. • A Collection facility should be set up in the district to collect domestic hazardous waste from both the Urban and rural areas of the district.	All ULBs & District Panchayati Raj officer (DPRO)
Training of sanitation workers regarding segregation of domestic hazardous waste	To ensure segregation of domestic hazardous waste from municipal solid waste	Training programmes should be organised at the state/district level for handling and segregation of domestic hazardous waste so that sanitation workers should not catch any kind of infection during its handling and its proper segregation could be possible.	State government and District Administration
IT-enabled systems for incentivization of the hazardous waste m	To ensure compliance to Hazardous waste management rule 2016.	The state pollution control board should inventory 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

Table 58.Action Plan for E-Waste

Action Point	Purpose	Strategy/Approach	Stakeholder Responsible
Establishing E-waste Collection Centers	• To ensure proper segregation of E-waste from municipal solid waste. • Capacity building of stakeholders to promote effective E-waste management.	• Collection centres should be established for all ULBs in such a way that they could also cater for 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 the district administration and urban local bodies. For that, Identity cards must 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 rules 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 of 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	• A random sampling of electrical and electronic equipment's placed on the market to monitor and verify the compliance of RoHS Restriction of Hazardous Substances) provisions as per the guidelines of Central Pollution Control Board (CPCB) • "E-waste Return" Programme should be initiated to incentivize people and bring about behaviour change	State government

Table 59. Action Plan for Wastewater Management (STPs)

Action Point	Concerning ULB	Strategy/Approach	Stakeholder Responsible	Purpose
Construction of Faecal Sludge Treatment Plant (FSTP)	All ULBs	• Reconnaissance survey and City Sanitation Planning is prerequisite for the construction of Faecal Sludge Treatment Plant.	State Government	• Treatment of Faecal Sludge/Septage • Reuse of bio-solids and treated wastewater
Decentralized wastewater management under (Atal Mission for Rejuvenation and Urban transformation (AMRUT) by Faecal Sludge and Septage Management system (FSSM)	All ULBs	• In line with the 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	• Periodic desludging of the on-site facilities such as septic tanks and leach pits etc. • Promoting community-planned and managed faecal sludge and septage management for a group of households. • Safe disposal of faecal sludge without affecting the water bodies and public health.
City sanitation plan under National urban sanitation policy	All ULBs	• Enhance synergy among municipal government agencies, the private sector, NGOs and others. • Increase funding from sources other than municipal government (such as from the national and provincial governments, donor agencies, the private sector)	Ministry of Housing and Urban Development, Government of India	• Citywide Sanitation Sector development. • Awareness generation and behaviour change in the field of Sanitation. • Sanitation and safe disposal of waste.

Revamping on-site sanitation facilities	All ULBs	The state-level policy should be framed for the design of on-site facilities such as septic tanks with the essential provisions of periodic desludging.	State Government	• To ensure compliance with IS 2470 Part 1&2 (Code of practice for installation of septic tanks)

Phytoremediation As A Mitigation Measure *(For Domestic Waste Water)*

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

Table 60.Phytoremediation as a Mitigation Measure *(for domestic waste water)*

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

ACTION PLAN FOR WATER RESOURCES MANAGEMENT AND GROUNDWATER EXTRACTION/CONTAMINATION

*Water Resources and Groundwater management requires an integrated approach from different departments such as District administration, Panchayati Raj, Jal Sansthan, Jal Nigam, Payjal Nigam, Forest Department etc. Each department is expected to work in tandem with each other to achieve effective management of resources, be it land or water.

Table 61. Water Resources Management

Action Point	**Strategy/Approach**	**Purpose**
Integrated water resources management (IWRM) at River basin level	By Considering basin/sub-basin as a basic unit for planning and management.	To achieve water security for all purposes, managing risks and mitigating disasters
River Basin Master Plan	By analysing River Basin Characteristics	Periodic review of hydrological conditions prevailing over a basin Identification of protected areas
Mapping of water-scarce areas in a district	• By using modern mapping tools such as GIS (Geographical Information System) and Remote sensing • By setting up an interdisciplinary framework consisting of Local institutions and empowered government agency	To get an estimate of vulnerable areas in the district.
Assessment of Water Resources in the various river basin	Using Modern technology and Hydrological modelling	To collect reliable data To assess water resources potential and analyse water requirements for various uses,
Public Awareness and Use of Low-Cost technologies	Using field application methods such as Drip irrigation/micro-sprinkler irrigation systems in water-scarce areas. This can be achieved by bringing government subsidies in this area as the local people needs	For better water application efficiency

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

Table 62.Action Plan for Groundwater Management

Action Point	**Strategy/Approach**	**Purpose**
Multidisciplinary Approach (Nexus between groundwater, agricultural policy, urban infrastructure and energy consumption)	By integrated vision and coordination amongst different departments.	For groundwater sustainability
Mapping of the aquifer at the micro-level	By Maintaining an Aquifer information and Management system	• To quantify the available groundwater resources • To formulate a plan appropriate to the scale of demands and aquifer characteristics.
Artificial recharge of Groundwater	• By demarcating groundwater recharge zones by identifying critical natural recharge areas of an aquifer and those areas that require special attention concerning recharge of groundwater. • By using broadleaf plants to improve the moisture content in the soil and thereby increase the groundwater level and water holding capacity of the soil. • Improving the scale of work done through various schemes such as MNREGA will help develop	• To ensure the sustainability of groundwater resources • To ensure the quality of recharge to prevent possible contamination

	indigenous recharge methods *(such as Chal-Khal).*	
Identification of Non-point sources of Pollution (Pollution resulting from land runoff, precipitation, drainage, seepage etc.)	• Controlling soil erosion by planting more trees and covering bare soil with vegetation. • Constructing wetlands.	Non-point source pollution is a leading cause of deteriorating water quality as when the runoff moves, it picks up and carries away natural and human-made pollutants finally depositing them in lakes, rivers and groundwater.
Mitigating Groundwater Contamination	• Reducing the use of pesticides and fertilizers. • Encouraging Organic farming in the area by organising various Information, Education and Communication (IEC) campaigns.	• To ensure the groundwater quality of an area. • To reduce health hazards caused due to contaminated water.

Table 63.Action Plan for Air Quality Management

Action Areas	Strategies/Approach	Stakeholders	Purpose
Air quality monitoring	Ambient air quality monitoring stations can be installed in all the urban centres and other identified areas such as construction sites after manual air quality monitoring.	Uttarakhand state pollution control board (UKPCB)	To identify the hotspots within the district and further development of mitigation measures for those areas.
Solid waste collection system	• 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 a proper collection mechanism, the provision of heavy fines should be made on the open burning of waste.	All ULBs and District Panchayati Raj Office (DPRO)	To reduce the emission of harmful gases by open burning of waste especially in urban areas.
Control over forest fires	• Providing the forest department with adequate manpower and machinery to manage the forests properly and 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. • The use of pine leaves could be done for making biofuel and further generation of electricity, Moreover, the collection of pine needles could be linked with MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Act).	Government of Uttarakhand and District Forest Department	To reduce harmful emissions due to massive forest fires in the district.

	• Development of mixed forests by planting indigenous broadleaf plants which maintain moisture in the soil and reduce the chances of a fire breakout.		
Vehicular Traffic management	• 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 to reduce road dust.	• Department of Police • Transport Department • Public works department	To reduce emissions caused by vehicles.
District level action plan for air pollution	A district-level task force with some experts can be formed for air quality management in the district.	District Administration	To improve existing air quality.
Awareness of air quality	Mass awareness can be promoted with IEC activities by involving institutions such as schools and colleges for this purpose.	District Administration	To promote awareness among the masses regarding the issue.
Complaint redressal system	Online complaint registration and redressal system should be formed at the district level to register complaints regarding air pollution issues.	• UKPCB (Uttarakhand state pollution control board) • District administration	To sort out grievances registered by citizens

Table 64.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.	UKPCB (*Uttarakhand state pollution control board)*
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. • Green belts can be formed along the roads in urban areas to reduce noise levels.	• District Administration • Public Works department and 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 involving institutions such as schools and colleges.	District Administration

Table 65. Mining Activity Management Plan

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

ACTION PLAN FOR REJUVENATION OF WATER BODIES

*Rejuvenation of water bodies requires an integrated approach from different departments such as District administration, Panchayati Raj, Jal Sansthan, Jal Nigam, Payjal Nigam, Forest Department etc. Each department is expected to work in tandem with each other to achieve effective management of resources, be it land or water

Action Point	**Strategy/Approach**	**Purpose**
River Catchment/Basin Management	• Participatory and self-management institutional framework for administering the catchment with a combination of engineering, social and scientific management.	Reducing levels of potential contaminants in raw water.
Plantation in Flood plain zones (FPZ)	• Vegetation that acts as naturally resistant to soil disturbances and standing water must be encouraged.	To reduce shoreline erosion Act as natural barriers to dissipate waves and back-lying areas from flooding.
Prohibition of disposal of Municipal Plastic waste and Biomedical waste (Especially in flood plain zones)	• A proper waste collection system should be implemented across the district. • Provision of heavy fines should be done on dumping of waste near water bodies	To maintain the ecological balance of the water body To stop pollution
Spring-shed and Stream shed management	• By Constructing loose boulder check dams. • Encouraging Information, Education and Communication (IEC) activities to ensure community participation.	To improve water resource sustainability To enhance water discharge from springs and rivers

**Key points for the action areas in this thematic are influenced by rejuvenation activities carried out for Kosi river(Almora), Bhela river(Kashipur) and Heval River(Tehri Garhwal)*

Table 66.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. • To ensure optimum utilisation of manpower	• ULBs should distribute separate bins to households, street vendors and other shopkeepers. • Distribution of separate bins to every household and shopkeeper 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 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 the door to door collection is not possible. • Provision of separate vehicles for dry and wet waste. • ULBs can establish linkage with the NGOs and private firms working in this field for effective waste collection in urban areas.	All ULBs, District Panchayati Raj Officer (DPRO), Village Panchayats
Linkage of ULBs & other collection centres with recyclers/ cement plants / Construction Agencies	• To avoid open dumping of plastic waste in landfills. • Higher recovery of resources.	• All the ULBs except NP Lohaghat should establish linkage with authorised recyclers. Plastic waste collection centres to be started in rural areas should also be linked with recyclers. • For disposal of multi-layered plastic linkage with some cement plants can be established. • Plastic waste can be used in road construction, for this ULBs should coordinate with the construction agencies such as Public Works Department.	All ULBs, DPRO (District Panchayati raj Officer),
Implementation of extended producer responsibility	To reduce the workload of ULBs	ULBs can ask the manufacturers collectively or individually in line with the principle of extended producer	All ULBs

(EPR) through producer/Brand owner		responsibility (EPR) to provide the required finance to establish plastic waste collection centres.	
Community participation for waste management	• Social and Behavioural Change • 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 the use of disposables and using alternatives like glass/Stainless steel etc. • To bring the 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

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