DISTRICT ENVIRONMENTAL PLAN

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

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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) facilitate the District Magistrates in preparing the District Environmental Plan (DEP) by placing a model plan on its website. This model plan may be adopted as per local requirements by all districts under the supervision of the District Magistrate. The said order also directs that the Department of Environment in respective states should collect district plans to prepare State Environment Plan (SEP), which shall be monitored by respective Chief Secretaries of the State by 15/12/2019. Based on State Environmental Plans, CPCB and Ministry of Environment, Forest & Climate Change (MoEFCC) shall prepare a National Environmental Plan (NEP), under the supervision of Secretary, MoEFCC and Chairman, CPCB.

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

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

Date:

Principal Investigator, Co-Project Investigators & Project staff

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

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ABBREVIATIONS

AMRUT	-Atal mission for Rejuvenation and Urban Transformation
APL	-Above Poverty Line
AR	-Assessment Report
As	-Arsenic
ASP	-Activated Sludge Process
ASSOCHAM	-Associated Chambers of Commerce and Industry of India
BHEL	-Bharat Heavy Electricals Limited
BMWMIS	-Biomedical Waste Management Information System
BOD	-Biological Oxygen Demand
BPL	-Below Poverty Line
C	-Carbon
C&D waste	-Construction and Demolition waste
CAAQMS	-Continuous Ambient Air Quality Monitoring Station
CACMP	-Catchment Area Conservation Programme
CAGR	-Compound Annual Growth Rate
CANTT	-Cantonment Board
CBG	-Compressed biogas plant
CBMWTF	-Common Bio-Medical Waste Treatment Facility
Cd	-Cadmium
CD	-Check Dam
CEMS	-Continuous Emission Monitoring System
CEPI	-Comprehensive Environmental Pollution Index
CETP	-Common Effluent Treatment Plant
CFL	-Compact Fluorescent Lamps
CGWB	-Central Ground Water Board
CH_4	-Methane
CHCs	-Community Health Care Centres
CK	-Chal Khal
CNG	-Compressed Natural Gas
CO	-Carbon monoxide
CO_2	-Carbon dioxide
COD	-Chemical Oxygen Demand
CPCB	-Central Pollution Control Board

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CPHEEO	-Central Public Health and Environmental Engineering Organisation
Cr	-Chromium
CSCs	-Community Sanitary Complex
CT	-Contour Trench
Cu	-Copper
dB	-Decibels
DDT	-Di-chlorodiphenyltrichloroethane
DFO	-Divisional Forest Officer
DIPSR	-District Industrial Profile Survey Report
DM	-District Magistrate
DO	-Dissolved Oxygen.
DPR	-District Project Report
DPRO	-District Panchayati Raj Officer
EC	-Environmental Clearance
EEE	-Electronics and Electrical Equipment
ENVIS	-Environmental Information System
EPI	-Environmental Performance Index
ESIPL	-Eldeco SIIDCUL Industrial Park Limited
ESS	-Environment Surveillance squad
ETPs	-Effluent Treatment Plants
E-Waste	-Electronic Waste
F	-Fluoride
FPZ	-Flood Plain Zones
FSI	-Forest Survey of India
FSSM	-Faecal Sludge and Septage Management system
FSTP	-Faecal Sludge Treatment Plant
GBPNIHE	-G.B. Pant National Institute of Himalayan Environment
GDP	-Gross domestic product
GES	-Global Environmental Solution
GIS	-Geographical Information System
GPIs	-Grossly Polluting Industries
GPS	-Global Positioning System
HCFs	-Health Care Facilities
HCL	-Hindustan Computers Limited

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ICT	-Information and Communication Technology
IEC	-Information, Education and Communication
IHHLs	-Individual Household Latrines
IIE	-Integrated Industrial Estate
INR	-Indian rupee
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
KFW	-Kreditanstalt Fuer Wiederaufbau
KLD	-Kilo Liters Per Day
LPG	-Liquefied Petroleum Gas
MBBR	-Moving Bed Biofilm Reactor
MDWS	-Ministry of Drinking Water and Sanitation
Mg	-Milligram
MGNREGA	-Mahatma Gandhi National Rural Employment Guarantee Act
MLD	-Millions of Litter Per Day
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
MPN	-Most Probable Number
MRF	-Material Recovery Facility
MSMEs	-Micro, Small &Medium Enterprises
MSW	-Municipal Solid Waste
MTPD	-Metric Ton per Day
NA	-Not Applicable
NAAQS	-National Ambient Air Quality Standards
NACP	-National Clean Air Program
NAPCC	-National Action Plan on Climate Change
NASA	-National Aeronautics &Space Administration

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NATCOM	-National Communication
NCEPC	-National Committee on Environment Planning &Co-ordination
NGOs	-Non-Governmental Organizations
NGT	-National Green Tribunal
NH	-National Highway
NIHL	-Noise induced Hearing Loss
NITI	-National Institution for Transforming India
NMHS	-National Mission of Himalayan Studies
NN	-Nagar Nigam
NP	-Nagar Panchayat
NPP	-Nagar Palika Parishad
NTFPs	-Non-Timber Forest Products
O&M	-Operation and Maintenance
OCEMS	-Online Continuous Effluent Monitoring System
ODF	-Open Defecation Free
OSHA	-Occupational Safety and Health Administrations
OSS	-On-site Sewage Systems
PAT	-Perform, Achieve &Trade
PCC	-Pollution Control Committee
pH	-Potential of Hydrogen
PHCs	-Primary Health Centre
PIBO	-Producer, Importer and Brand Owner
PM	-Particulate Matter
PPCP	-Polypropylene Copolymer
PPP	-Polluter Pays Principle
PRO	-Producer Responsibility Organization
PSUs	-Public-Sector Undertaking
PT	-Percolation Tank
PUC	-Pollution under Control
PWD	-Public Works Department
QPD	-Quintal Per Day
RBMs	-Riverbed Minerals
RoHS	-Restriction of Hazardous Substances
RSM	-Rural Sanitary Marts

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RTO	-Regional Transport Officer
RTRWH	-Rooftop Rain Water Harvesting
SBC	-Soil Bowl Centrifuge
SBM-G	-Swachh Bharat Mission Gramin
SDGs	-Sustainable Developmental Goals
SIDCUL	-State Industrial Development Corporation of Uttarakhand Limited
SLWM	-Solid and Liquid Waste Management
SPCB	-State Pollution Control Board
SPM	-Suspended Particulate Matter
SSMG	-Sustainable Sand Management Guidelines
STP	-Sewage Treatment Plant
TKN	-Total Kjeldahl Nitrogen
TPD	-Tonne Per Day
TSDF	-Treatment Storage and 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

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EXECUTIVE SUMMARY

The district is currently in development phase with new towns emerging as an Industrial hub. There is no doubt that these industrial estate brings economic prosperity but growing environmental concerns (such as increase in solid waste generation, air and noise pollution., waterbody pollution etc.) due to this development needs to be understood. 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 status and to furnish a comprehensive plan in view of mitigating environmental deterioration, GBPNIHE was assigned the task to prepare district Environment plan of Udham Singh Nagar (U.S. Nagar). Detailed deliberations were carried out to devise the action plan focusing on explicit thematic areas which are as under:

- ***Waste Management Operations:*** Solid waste generated in U.S. Nagar is amongst the highest in the state of Uttarakhand. However, the waste management operations in each ULB are different to a large extent. Some of them have optimum infrastructure for waste processing and disposal while some lack even basic facilities like those required for wet waste management.
- Lack of availability of land for waste disposal is a big issue in the district. Some ULBs are disposing the waste is some private land in mutual consonance with the owner.
- Based on our estimation, solid waste generation in the district is expected to surpass 400 MTPD by 2040. This means that scientific management will become necessary to accommodate such huge quantity of waste.
- Hazardous waste generated from the industries is quantified. They are the major sources of toxic waste. However, Hazardous waste is currently not streamlined in waste management operations in different ULBs and exists in a mixed form
- ***Biomedical Waste Management:*** Biomedical waste generated in the district is lifted regularly by Common Biomedical Waste Treatment and Disposal Facility (CMBWTF) at Gadarpur. Maximum healthcare facilities are operating under the consent of Uttarakhand Pollution Control Board.
- Biomedical waste generated in domestic households could not be segregated and therefore exists as mixed waste.

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- ***Construction and Demolition waste management:*** C&D waste generated in the district is used locally to fill some low lying area and other minor repairing works. At present, there is no such policy that might have been framed for scientific management of C&D waste.
- ***River Polluter Stretches in U.S. Nagar district***: As much as 7 river polluter stretches have been identified in the district which is a big ecological concern. Lack of scientific waste water treatment, industrial effluent and illicit solid waste disposal are some of the reasons for poor water quality of the rivers. Action plans have been prepared for restoration of each polluter stretch as directed by Hon'ble NGT.
- ***Non-Attainment City-Kashipur***: Industrial pollution, vehicular pollution etc. are some of the reasons for deteriorating air quality in Kashipur town. One of the monitoring stations has recorded elevated particulate matter levels for quite some time. Action plan has been prepared as a part of National Clean Air Program (NCAP) and directions of Hon'ble NGT for improving air quality in the town and its vicinity.
- ***Waste water Management***: Several STPs have been proposed for scientific waste water treatment in U.S. Nagar district (Currently, the households/commercial establishment uses septic tanks for waste water management). Major works include interception and diversion works of *nalas* in the cities which will be tapped and connected to the proposed STPs. Sewerage connection for waste water from domestic households has also been visioned in near future which will then form part of co-treatment as envisaged by the department.
- ***Industrial Waste Water Management***: Two CETPs are available for industrial waste water treatment, one in IIE SIDUCL Pantnagar and another in Sitarganj. Major polluting industries are connected with the CETP and monthly effluent discharge outlet values are available for these two CETPs.
- ***Industrial Clusters***: IIA Pantnagar, Rudrapur has been declared as critically polluted with a CEPI score of around 77.7 out of 100. Industries, mainly plywood industries and corn processing units have been the major sources of pollution in this industrial area.
- Action plan has been prepared as per order of Hon'ble NGT to bring down the pollution levels in IIA Pantnagar, Rudrapur.
- ***Air and Noise Pollution:*** Air pollution is one of the major environmental concerns in the district. This pertains to the fact that the district is major industrial hub of the state. Non industrial pollution sources such as vehicles, stubble burning etc. also contribute to the increasing air pollution in the district.

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- Manual air quality Monitoring stations have been installed at different locations (in Kashpiur and Rudrapur) to ascertain air quality index. Particulate matter values (specifically PM_{10}) have exceeded the prescribed standards almost in every year.
- Noise levels are measured at 6 locations (different zones) majorly in Nagar Nigam Kashipur and Nagar Nigam Rudrapur. Generally, the Noise levels elevates during festive times.
- ***Surface and Groundwater Management:*** Most of the rivers in the district are non –perennial and are usually dry in lean season. Some stretches of these rivers have been identified as if polluted. Industrial and domestic drains are emptied in the river which has negative implications for riverine ecology.
- Tube wells is one of the major sources of drinking water in the district. As many as 11 groundwater monitoring stations are available in the district to ascertain the groundwater quality. At present, major groundwater blocks are categorised as semi-critical or safe.
- ***Mining activity:*** Ample revenue is generated majorly through sand mining in the river flood plains. Some illegal mining activities have been brought to notice for which penalties were imposed.

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

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INTRODUCTION

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

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would apprise about the present environmental issues and a strategy to meet the targets for the future (Sandhu and Sandhu, 2015).

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

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

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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

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

Public Trust Doctrine

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

Public Liability Insurance

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

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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

Contemplated to be the "Gateway of Kumaon Hills", Udham Singh Nagar, (named after a notable freedom fighter, Shaheed Udham Singh) is a district in the state of Uttarakhand with its headquarters in Rudrapur.Once part of the district of Nainital,Udham Singh Nagar is a Terai (plain) region of the state of Uttarakhand.It is bounded on the north by Nainital district, on the northeast by Champawat district (Fig. 1). Moreover, it shares international boundary on the east with Nepal and national boundary on the south with Uttar Pradesh. National highway 109 (NH 109), one of the most important routes, runs through the district connecting the entire Kumaon region to the state as well as the country.The district has a rare sight seeing as it is surrounded by Kumaon Himalayas on one side and Nepal on the other.

Also considered as the "*Rice bowl of Uttarkhand"*, Udham Singh Nagar is famous for its agriculture and irrigation on synchronized pattern from the past as garner of popularity for its productivity in paddy crops in the whole Uttarakhand state. The fertile land lends itself to different forms of cultivation giving rise to agriculture related activities and industries. Pantnagar University is a leading temple of learning in the field of agriculture and technology with one of the finest built university all around the world.

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Agriculture based industries are found throughout the district in all blocks and tehsils. Lately, the industrial aspect has been transformed with the upcoming of State Industrial Development Corporation of Uttarakhand Limited (SIDCUL) and Integrated Industrial Estate) IIE at Pantnagar and Sitarganj, making it an agro-industrial district. The area is also evolving as a manufacturing base for automobile parts or vehicles, paper products, food product based industries etc. In past few years, many renowned automobile industries like TATA motor, Bajaj, Ashok Leyland, Mahindra and Mahinda have set up their manufacturing plants in Udham Singh Nagar district.

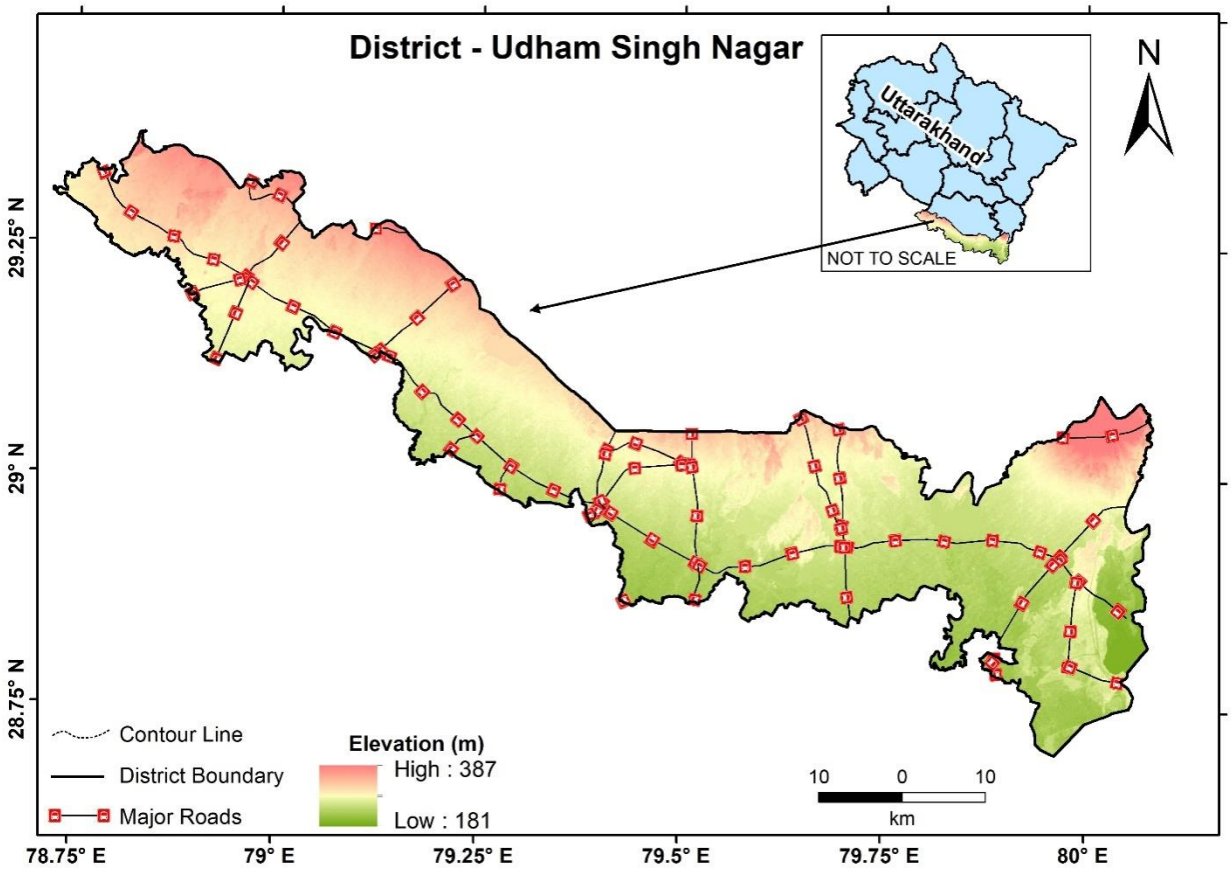

Fig. 1. Location map of Udham Singh Nagar district

District at a glance

Various attributes such as geographical aspect, population data and administrative setup of U.S. Nagar district are shown in Table 1.

Table 1. District at a glance

Geographical Location	
Latitude	28° 53' N - 29° 23' N
Longitude	78° 45' E - 80° 08' E
Geographical Area	2542 km^2

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Average elevation of district headquarter	527 m
Population Data (2011 census)	
Total Population	1,648,902
Male Population	858,783
Female Population	790,119
Population density	649
Decadal population growth rate	33.44%
Overall Literacy rate	73.10%
Male literacy	81.09%
Female literacy	64.45%
Sex Ratio	920
Urbanised area	122.21 km^2
Rural area	2,419.79 km^2
Administrative Division	
Tehsils	07
Blocks	07
Nyay Panchayats	46
Village Panchayats	308
Total census villages	643

Source: Census data, 2011 &District statistical report 2019

Physiography

Since the district is seated in the Himalayan foothills, particularly the Shivalik Foothills, a very thick column of alluvium is deposited in the region. These lower foothills were densely forested till denuded by the British log merchants and later after independence by forest contractors. The district is broadly divided into two physiographic units from north to south, Bhabar and Terai respectively. The Bhabar region is exposed immediately south of the Shivaliks of the Himalayan foothills whereas the Tarai formation (Name derived from marshy conditions) is located to the south of the Bhabar formation. The contact between these two hydro geomorphic units is characterised by the change in slope and groundwater effluents, which forms the spring line (Table 2).

Table 2. Physiographic Divisions

Relief Feature	Width	Soil Type	Major areas
Bhabar	Less than 30 km	Gravel, Boulders, Silt, clay with pebbles	Northern extremities of Bazpur and Khatima Blocks
Tarai	8- 25 km	Calcareous, fine silt, sandy clays	Immediate south to the Bhabar formation

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Agriculture and Drainage Patterns

Udham Singh Nagar has a dense network of the drainage pattern. Agriculture is the primary occupation of the people as it justifies the title of *"Chawal ki Nagri".* About 64% of the total work force is engaged in farming the very fertile land. It is observed that the rice crop is grown three times in a year. Owing to the diverse network of rivers, canals and major reservoirs, ample water is available to meet the irrigation demand throughout the year.

The major rivers are perennial, whereas their tributaries originating from Sub-Himalayan zone are ephemeral and remain dry during the non-monsoon seasons (Table 3). The overall drainage pattern in the district is sub dendritic to sub parallel.

Table 3. Drainage system in US Nagar

Drainage system	
Major Rivers and Canals	Kosi
	Sarada
	Gola
	Phikka
	Sarada
	Gandli
	Sukhi
	Katna
	Kailash
	Kaman
	Sanedi
Major Reservoirs	Tumaria (Jaspur)
	Gularboj
	Dron
	Sarada Sagar (Khatima)
	Haripura (Gadarpir)
	Nanak sagar (Sitarganj)

Climate

Since the district is located in the northern plains, it experiences moderate weather all through the year with slightly chillier winters and warm summers. The climate varies from Sub-tropical and sub-humid with three distinct seasons i.e. summer, monsoon (rainy season) and winter season. The maximum temperature in the district goes upto 42ºC during the summers and the minimum temperature varies between 1ºC to 4ºC.Further north to the district, the temperature comes, dips to 0.4 ºC in winter season.

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Rainfall

Rainfall spatially is highly variable depending upon the altitude. The intensity of the rainfall increases from south to north and the amount of rainfall decreases in generally from west to east. About 90% of the rainfall occurs in the monsoon period with average annual rainfall has been measured to be962.00 mm (Guhathakurta et al, 2020).

Groundwater

The groundwater is the major source in the district for fulfilling the demands of irrigation, domestic and industrial purposes. Based on the behaviour and occurrence of groundwater, the district has been broadly classified in two hydro geomorphic units namely Bhabar and Tarai. The contact between these two regions is characterized by the change in slope and groundwater effluents which form the spring line. The groundwater appears to be sustained and recharged by direct infiltration from precipitation on the land surface and infiltration from turbulent streams flowing across the belt. Considerable amount of water is also discharged by perennial springs at the southern limit of Bhabar region during the monsoon. The formation is favourable to percolate the water laterally from Bhabar to Tarai and the older alluvium further south. Central groundwater Board has established 28 groundwater monitoring wells to monitor the groundwater regime periodically and to study the hydrogeological behaviour of the aquifers in the district. Deep tube-well (81.3%) and Shallow tube well (18.7%) are the only two dominant water sources used for water supply schemes over the district except for a single case using Open well. No block in Udham Singh Nagar district is found to harvest springs for water supply, primarily due to unavailability of springs at lower elevation.

Forest

According to the State Forest report of India 2019, the recorded forest area/forest cover of the US Nagar is 431.79 km^2which constitutes 16.98% of its geographical area. Very-dense forest constitutes149.16 km^2(5.875%), moderately dense constitutes 188.75 km^2 (7.428%), and open forest constitutes149.16 km^2(3.70%) of total forest area (Table. 4) (FSI, 2019). Various important species of trees in the Udham Singh Nagar namely, Sal (*Shorea robusta*), Sagon (*Tectona grandis*), Popular (*Populus spp*.), Samel (*Bombax ceiba*), Bel (*Aegle marmelos*), Guava (*Psidium guajava*), and Mango (*Mangifera indica*) etc. are prevalent in the forest areas of the district, moreover the major forest produce are fruits, timbers and medicinal plants.

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Table 4. Total Forest Cover of US Nagar district in 2019 survey (FSI, 2019)

Particular	Geographical Area	Very Dense Forest	Mod. Dense Forest	Open Forest	Total	Changes as of 2017-2019 assessment
Forest Area of US Nagar (km^2)	2542	149.16	188.75	93.88	431.79	-4.21

Flora and Fauna

Flora

Being at a transition zone between two heterogeneous domains, fertile soil with abundance of moisture has sustained rich floristic diversity in the district. Originally, Tarai region harbours sub-montane seasonal broadleaf forests however, the clearing of forests (due to rapid urbanization, intensive agriculture) have led to absence of native trees, shrubs which have been replaced by weeds and grasses. This has led to addition of more alien vegetation elements. Major part of the floral diversity comprises of Taxa cultivated for various purposes (Crops, ornaments, germplasm collections etc.) and the remaining exist as wild plants growing as indigenous taxa or weed. Various important species namely, Sagon (*Tectona grandis*), Sal (*Shorea robusta*), Bel (*Aegle marmelos*), Asthma Plant (*Euphorbia hirta*), Pomegranate (*Punica granatum*), and False Daisy (*Eclipta prostrata*) etc. are still prevalent in US Nagar.

Fauna

The district is a natural sanctuary for Squirrel (*Funambulus pennantii*), Langur (*Canis familiaris*), Wild boar (*Sus scrofa*), Monkey (*Macaca mulatta*), etc. The region also hosts remarkable common bird's species such as Common myna (*Acridotheres tristis*), Black Bulbul (*Molpastes cafer*), Spotted Dove (*Streptopelia chinensis*), possessing plumage of magnificent design and colours. Surai Forest area is a famous forest region located about 20km from Khatima which forms an enclosure for the varied flora and fauna thriving in the range. Various species of colourful birds can be seen throughout the region. Crocodiles are found in good numbers in this forest range. Major attraction of this region is the abundance of wildlife species and bird species that can be seen enhancing the ambience of the district

Industrial scenario of district

The development of industries is attributed largely to the setting up of large Integrated Industrial Estate(IIE) under State Infrastructure and Industrial Development Corporation of Uttarakhand Limited(SIDCUL). This has propelled the district into the forefront of industrial activity and has attracted numerous companies. US Nagar is a hub or Automobile industries, Paper industries, Rice mills and sugar mills industries, all large scale industries established here have more than

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200 hundred vendors which sequentially offers lot of scope in vendorisation in all categories (Table 5).

Table 5. Major companies in the district

Name of Company	Type
Tata Motors	Automobile
LSC Infratech	Infrastructure
Delta power Solutions	Power
Kumar Autowheel Pvt. Ltd.	Automobile
Time Technoplast Limited	Packaging
Nestlé India	Food processing
Bajaj Auto	Automobile
Dabur India Limited	Consumer goods
TVS Motors Unimax Limited	Automobile
Parle Agro	Consumer goods
HCL	IT services
Mahindra Tractor	Automobile
Greenply Industries Ltd.	Interior Infrastructure
Ashok Leyland	Automobile
Hindustan Zinc limited	Mining, Smelting
Britannia Industries	Food Processing
Micromax	Electronics

Culture and Tradition

The district is popularly known as *"Mini Hindustan*" for it boosts with people of diverse culture, tradition, religion and lifestyle living together in harmony and brotherhood proving the *"Unity in Diversity"* theme of India. The state maintains a secular ambience with significant number of people belonging to different faiths like Islam, Sikhism, Buddhism and Christianity. The district is dotted with number of shrines for Hindus and Sikh devotees. Nanak Mata an important holy shrine of Sikh religion is visited by a large number of Sikh pilgrims every year. Atariya Temple (dedicated to goddess Durga) is visited by hundreds of devotees every year. Other famous temples in the district Chaiti Devi Temple, Giri Sarovar etc.

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ENVIRONMENTAL CONCERNS IN THE DISTRICT

Urbanization and developmental activities have made a profound impact on the ecology of the urban area of the district. An increasing number of vehicles in the cities have led to air pollution due to vehicular emissions. The rapid industrialization in the district has led to the setting up of factories which produce poisonous smoke and effluents in to the environment deteriorating the air and water quality. This increase in the level of pollution is engulfing the hill state of Uttarkhand. The air in the city is contaminated with toxic chemicals like carbon mono oxide (CO), oxides of Sulphur and nitrogen reactive hydrocarbons, heavy metal lead and organic compounds. Many industries have been found operating in violation to the environmental norms as neither Green belts nor sufficient ETP/STPs have been developed for effluent treatment.

The urgent need for urbanization has created increasing demand for land, housing, transport, water supply, sanitation and health facilities leading to development of buildings, houses, multi-complexes, shops, industries in an unplanned manner causing spoilage of landscape by converting agricultural land and forest cover putting more pressure on the already stressed ecosystem. Udham Singh Nagar is one of the few districts which has seen negative growth in their forest area. Introduction of several private infrastructures related schemes is one of the main reasons behind depleting cultivable land. Moreover, unsuitable garbage management has engulfed the city of Rudrapur where Municipal Corporation is facing the wrath of the public for improper waste management amid rapid urbanization.

Groundwater extraction, however appears to be ecologically balanced, has increased over the time in the district. It is observed that a few streams have disappeared in past years to compensate for groundwater extraction. The concretization of dry streams has further elevated the issue even as these streams are groundwater recharge windows through which monsoon replenishes the aquifer. Most of the flowing well in the zone area are devoid of any mechanism to control and regulate their flow. In other words, their non-capping has led to decrease in pressure heads and wastage of the valuable groundwater resource.

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DATA AND IMPACT ANALYSIS

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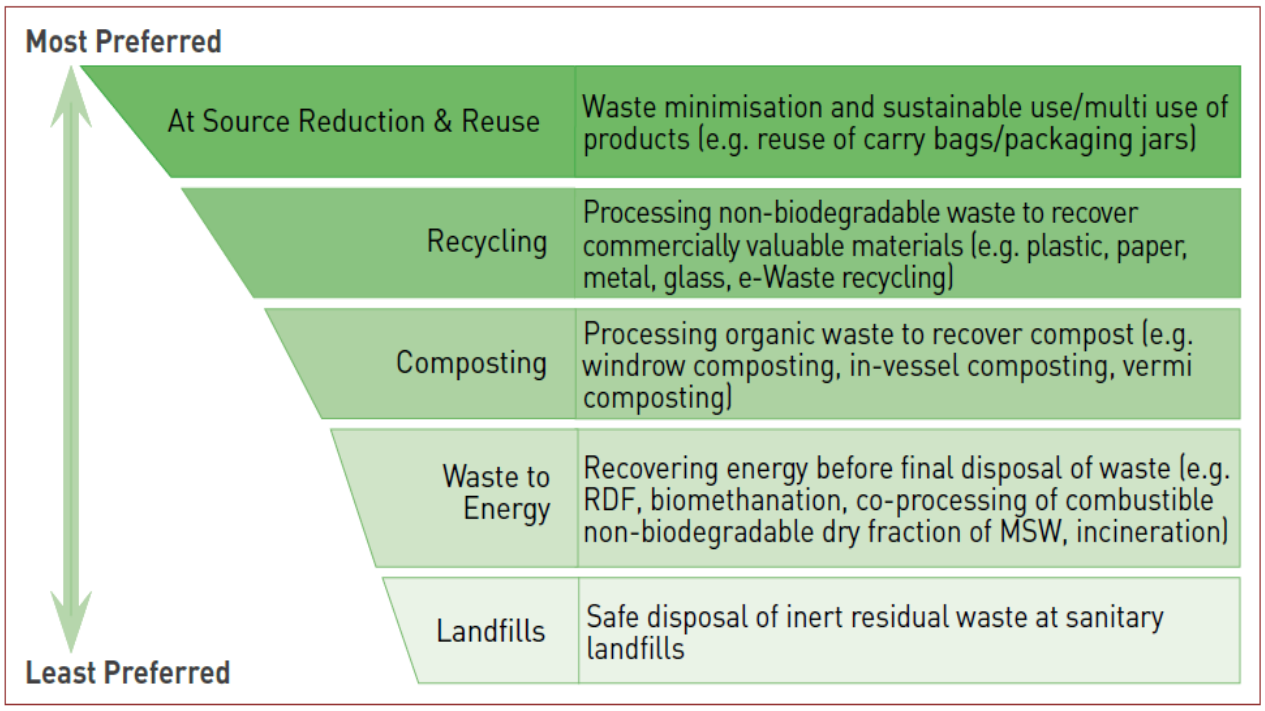
SOLID WASTE MANAGEMENT

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

Integrated Solid Waste Management (ISWM)

It is based on the waste management hierarchy, with an aim to reduce the amount of waste being disposed while maximizing resource recovery and efficiency (Fig. 2). Based on this waste management hierarchy, an assessment of local needs and conditions should lead to the selection of an appropriate mix of process and technologies.



Source: CPCB (Central pollution Control Board)

Fig. 2. Segregation of Biomedical waste as per BMW rules, 2016

Solid Waste management in Udham Singh Nagar District

Waste generation in the district varies from about 50 MT in Kashipur to as low as about 1 MT in Shaktigarh (Table 6). Primary waste management operations are optimum in some ULBs but some of them are lacking even basic operations such as source segregation. Each ULB has established linked with some private agencies for waste collection transportation etc. (Table 7).

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Table 6. Inventory of total solid waste generation

Name of Urban Local Body	Population (2011)	Number of Wards	Solid waste generation (MTPD)			
			Dry	Wet	*Other waste	Total
Nagar Nigam Kashipur	175819	40	20.80	31.20	NE	52
Nagar Nigam Rudrapur	175723	40	15	30	20	65
Nagar Palika Parisad Gadarpur	23289	11	2.59	2.58	2.83	08
Nagar Palika Parisad Bazpur	31172	13	9.5	2.5	NE	12
Nagar Palika Parisad Jaspur	50523	09	15	10	NE	25
Nagar Palika Parisad Kichha	74356	20	12	08	05	25
Nagar Palika Parisad Sitarganj	31711	13	04	15	NE	19
Nagar Palika Parisad Khatima	58494	20	NE	NE	NE	18
Nagar Panchyat Mahua Kheraganj	12584	09	1.4	0.6	NE	02
Nagar Panchayat Mahua Dabra	7326	07	0.54	0.9	0.36	1.8
Nagar Panchayat Sultanpur	9881	07	2.4	1.6	NE	4.0
Nagar Panchayat Kelakhera	10929	09	1.3	2.0	01	4.3
Nagar Panchayat Dineshpur	11783	09	3.0	2.5	NE	5.5
Nagar Panchayat Shaktigarh	6314	07	0.2	01	0	1.20
Nagar Panchyat Nanakmata	8478	07	NE	NE	NE	4.03
Nagar Panchyat Gularbhoj	6957	07	1.3	1.6	0.1	03

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

(Sources: Nagar Nigam, Nagar Palika Parishad and Nagar Panchyat Udham Singh Nagar, 2021)

Table 7. Waste management operations

Waste management operations	Outcome	
	ULB	***Source Segregation* (%)**
Segregation at source	NN Kashipur	50
	NN Rudrapur	90
	NPP Gadarpur	70
	NPP Bajpur	Not initiated
	NPP Jaspur	Not initiated
	NPP Kichha	30-40 (in 15 wards out of 20)
	NPP Sitarganj	40
	NPP Khatima	Not initiated
	NPP Mahuwa Khedaganj	50
	NP Mahuwadabra	40-50
	NP Sultanpur pati	10
	NP Khelakheda	10(in 5 wards out of 9)

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	NP Dineshpur	70
	NP Shaktigarh	60-70
	NP Nanakmatta	25
	NP Gularbhoj	70(in 5 wards out of 7)
Door to Door Collection	All the ULBs in the district are accomplishing 100% door-to-door collection.	
Sweeping	All the ULBs in the district are accomplishing 100% sweeping by manual method (NN Rudrapur is performing mechanical sweeping in some areas).	

Segregated waste Transport	ULB	Segregated Waste Transport (%)
	NN Kashipur	50
	NN Rudrapur	70
	NPP Gadarpur	80
	NPP Bajpur	Not initiated (Combined transport)
	NPP Jaspur	Not initiated
	NPP Kichha	40
	NPP Sitarganj	Not initiated
	NPP Khatima	80
	NPP Mahuwa Khedaganj	50
	NP Mahuwadabra	Not initiated
	NP Sultanpur pati	10
	NP Khelakheda	10
	NP Dineshpur	70
	NP Shaktigarh	60
	NP Nanakmatta	25
	NP Gularbhoj	80

Material Recovery Facility (MRF) operation	ULBs having operational Material Recovery facility	ULBs without Material Recovery facility	Recovery facility under construction
	• NN Kashipur • NN Rudrapur	• NPP Gadarpur • NPP Jaspur • NPP Kichha • NPP Khatima • NP Mahuwadabra • NP Khelakheda • NP Dineshpur • NP Shaktigarh • NP Nanakmatta • NP Gularbhoj	Bajpur Sitarganj NPP Mahuwa Khedaganj Nagar Panchayat Sultanpur

Involvement of Non-Governmental Organizations (NGOs) / private agencies	***Private Agencies/NGOs***	***ULB***
	K.P.S Envirotech group, Muradabad	NPP Gadarpur
		NPP Kichha
		NP Khelakheda
		NP Dineshpur
	Public Associate,Rudrapur	NP Gularbhoj

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		NPP Khatima
		Nagar Panchayat Sultanpur
	Bhagwati Enterprises	NPP Sitarganj
	Akanksha Enterprises	NN Rudrapur
	Nivarana Seva Samiti	NPP Bajpur
	Zero waste	NPP Mahuwa Khedaganj
	A.R. Service	NP Mahuwadabra
	Konark Global Service, Rudrapur	NN Kashipur

	ULB	***Number of authorized waste pikers***
Authorization and issuance of identity cards to waste pickers/sanitation workers	Nagar Nigam Kashipur	447
	Nagar Nigam Rudrapur	346
	Nagar Palika Parishad Gadarpur	32
	Nagar Palika Parishad Bajpur	52
	Nagar Palika Parishad Jaspur	121
	Nagar Palika Parishad Kichha	166
	Nagar Palika Parishad Sitarganj	64
	Nagar Palika Parishad Khatima	116
	Nagar Palika Parishad Mahuwa Khedaganj	50
	Nagar Panchayat Mahuwadabra	23
	Nagar Panchayat Sultanpur patti	34
	Nagar Panchayat Khelakheda	12
	Nagar Panchayat Dineshpur	43
	Nagar Panchayat Shaktigarh	16
	Nagar Panchayat Nanakmatta	21
	Nagar Panchayat Gularbhoj	19
Linkage With Treatment Storage and Disposal Facilities (TSDF)/Bio-Medical Waste Treatment Facility (CBMWTF)	Only NN Rudrapur has established linkage with a TSDF namely Global Envirotech, Lambakhera.	

(Sources: District Administration,2021)

Waste management infrastructure and processing in US Nagar

Apart from hand trolleys, mini collection trucks, some ULBs are also using E-rickshaws for waste collection and transportation. Private land is being used for waste disposal in the ULBs with no established landfill or dumping ground (Table 8). Wet waste composting pits have been constructed either in the dumping ground or any other designated areas in the district. Dry waste processing is still in its early stage as district lack scientific recovery facility in most of the ULBs (Table 9).

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Table 8. Present Infrastructure for Waste Management

Name of ULB	Inventory of Infrastructure involved in waste management operation					
	Waste collection trolleys/Rickshaws	Mini collection trucks/ tractors/ Others.	Composting units/ on-site composting facilities	Material Recovery Facility (Available/Not Available)	Landfills (Dumping ground/ Trenching Ground/sanitary landfills)	Remarks
NN Kashipur	200	37	21	Available	Dumping zone	E-rickshaws are being used for waste collection in Nagar Nigam.
NN Rudrapur	100	42	30	Available	Dumping ground	Waste in being disposed in a dumping ground of area 1.5-2.0 ha.
NPP Gadarpur	45	09	10	Not Available	Dumping ground	Waste is being disposed in a land leased by Nagar Palika.
NPP Bajpur	25	11	10	Under Construction	Trenching ground	Material recovery facility is under construction in land near to trenching ground.
NPP Jaspur	100	10	Not Available	Not Available	Dumping ground.	Waste is being disposed in a land leased by Nagar Palika.
NPP Kichha	80	23	05	Not Available	Dumping ground	• Plastic waste is compacted in a transfer point of nagar palika. • Left over waste is disposed in a private land.
NPP Sitarganj	10	55	03	Under Construction	Trenching Ground	Waste is collected through rickshaws and hand trolleys.
NPP Khatima	70	12	00	Not Available	Dumping Ground	Dry waste is not processed in Nagar Palika Khatima.
NPP Mahuwa Khedaganj	09	10	13	Under Construction	Trenching ground	Recovery facility will be soon provided power supply to make it operational.
NP Mahuwadabra	10	09	06	Not Available	Dumping ground	Both Rickshaws and hand

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						trolleys are also part of the fleet for waste collection in Nagar Palika.
NP Sultanpur	07	06	04	Under construction	Dumping ground	Waste is being disposed in private land for filling the low lying area.
NP Khelakheda	15	04	00	Not Available	Dumping ground	Waste is being disposed in private land for filling the low lying area.
NP Dineshpur	20	04	08	Not Available	Dumping ground	Wet waste composting pits have been constructed in different wards and government buildings.
NP Shaktigarh	04	10	03	Not Available	Dumping ground	Twin compartment e-rickshaws are used for waste collection and transportation.
NP Nanakmatta	16	09	02	Not Available	Dumping ground	Civil works have been started for the construction of new trenching ground.
NP Gularbhoj	20	03	04	Not available	Trenching ground	Instead of hand trolleys, rickshaws are used for waste collection in Nagar Palika.

Table 9. Methods of treatment, disposal and recovery

Name of ULB	Wet waste management	Dry Waste Management (waste to Energy/Recycling/incineration/ open Dumping in Trenching ground/ sanitary landfill)	Remediation of the old dump site
Nagar Nigam Kashipur	Composting machine is available at transfer point for wet waste processing of the segregated waste received. Manure thus formed is sold to local people at a rate of Rs. 3/kg.	• Dry waste is being segregated majorly into four categories (plastic, iron, card board and paper) by outsourcing firm Konark Enterprises. • After compaction, the plastic waste is sold to local rag pickers.	ULB is working with Ram Singh Agarwal Pvt. Ltd. for the remediation of 35000 MT legacy waste in the old dumping site.
Nagar Nigam Rudrapur	Out of 30 composting pits, 12 are available in government colonies. Rest 18 pits are	• Dry waste is being segregated majorly into four categories (plastic, glass, card board and paper) by Akanksha Enterprises.	Reclamation of part of dump site is underway. Daily waste processing is a carried out in the

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	constructed in different wards of Nagar Nigam.	• After compaction, the plastic waste is sold to local rag pickers. • Dry Residual (Inert waste) is dumped in the trenching ground.	segregation shed in leftover part of dumping zone.
Nagar Palika Parishad Gadarpur	Wet waste is being processed in composting pits constructed near to disposal site.	• Dry waste is segregated into different categories manually by outsourcing firm K.P.S. envirotech. • The segregated plastic waste is sold to local ragpickers under the jurisdiction of Nagar Palika. • Left over waste is used for either filling of low lying area or is disposed in dump site.	No old dump site exists within the ULB.
Nagar Palika Parishad Bajpur	Wet waste is being processed in the composting pits near the site of under construction material recovery facility.	• Dry waste is segregated into different categories manually by outsourcing firm Nivaran Seva samiti. • Plastic waste after compaction is sold to local rag pickers.	No old dump site exists within the ULB.
Nagar Palika Parishad Jaspur	Not initiated	Dry waste is not processed in Nagar Palika Jaspur.	No old dump site exists within the ULB.
Nagar Palika Parishad Kichha	• Composting pits have been constructed in different areas of the ULB. • Moreover, one composting machine is also available with the ULB.	Dry waste is segregated in dumping ground by outsourcing firm K.P.S. envirotech. Plastic waste after compaction is sold to local ragpickers under the jurisdiction of Nagar Palika.	No old dump site exists within the ULB.
Nagar Palika Parishad Sitarganj	03 composting pits have been constructed in different areas of the ULB.	Collection, segregation and transportation of waste is done by private firm named Bhagwati Enterprises. Plastic waste after segregation is sold to local rag pickers.	There is an old dump site comprising of almost 9904 MT waste.
Nagar Palika Parishad Khatima	Not initiated	Collection and transportation of waste to the dumping ground is done by outsourcing firm named Public Associates Rudrapur. Waste is not segregated in the dumping ground. Hence dry waste is not quantifiable and processed.	There is an old dump site having area of approximately 1500m^2
Nagar Palika Parishad Mahuwa Khedaganj	13 Composting pits and a composting machine is available for wet waste processing in trenching ground.	Collection and segregation of waste is done by private agency named Zero waste. Plastic waste after compaction is sold to local rag pickers under the jurisdiction of Nagar Palika.	No old dump site exists within the ULB.
Nagar Panchyat Mahuwadabra	03 composting pits are available in trenching ground for wet waste management. Three more pits are in construction.	Collection and segregation of waste is done by private agency named A.R. service. Plastic waste is sold to local rag pickers under the jurisdiction of Nagar Palika.	No old dump site exists within the ULB.

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Nagar Panchyat Sultanpur patti	Wet waste is processed in 04 composting pits	Collection and segregation of waste is done by private agency named Public Associate, Rudrapur. Plastic waste after compaction is sold to local rag pickers under the jurisdiction of Nagar Palika.	Legacy waste has been excavated from the old dumpsite in Nagar palika.
Nagar Panchyat Khelakheda	Not initiated. However a site has been recognized for centralized wet waste composting.	• Collection and segregation of waste is done by private agency named K.P.S. envirotech. • Plastic waste is sent to a facility in Haldwani which is then further processed.	No old dump site exists within the ULB.
Nagar Panchyat Dineshpur	08 composting pits are operational in different areas of the ULB.	Waste management operations are handled by a private firm named K.P.S enviro tech. Plastic waste is sold to local rag pickers under the jurisdiction of Nagar Palika.	One old dump site has been remediated.
Nagar Panchyat Shaktigarh	03 composting pits are available in dumping site for wet waste management.	Dry waste is not processed in the ULB.	No old dump site exists within the ULB.
Nagar Panchyat Nanakmatta	02 composting pits are operational for wet waste management.	Dry waste is not processed in the ULB.	No old dump site exists within the ULB.
Nagar Panchyat Gularbhoj	04 composting pits are available in trenching ground for wet waste processing.	Collection and segregation of waste is done by private agency named K.P.S. envirotech. Plastic waste after compaction is sold to local rag pickers under the jurisdiction of Nagar Palika.	No old dump site exists within the ULB.

Gap identification and proposed policies for effective waste management in Udham Singh Nagar

Source segregation is completely missing in some ULBs of Udham Singh Nagar. Except for two, all ULBs are lacking material recovery facility which is hampering their ability to process the dry waste accumulated. Disposal of waste has also been an issue in the district as government authorised landfills and disposal according to SWM rules, 2016 is hard to find (Table 10). However, each ULB has its DPR approved to overhaul their waste management operations. Most of them have proposed integrated solid waste management in a cluster based approach (Table 11).

Table 10. Gap identification

Name of ULB	Observed Shortcomings	Remarks
NN Kashipur	Partial source segregation of waste	ULB has achieved only 50 % source segregation.
	Partially segregated waste transport	Complete segregated waste transport would be possible once 100% source segregation is achieved.
	No Linkage with authorized waste recyclers.	Recyclable dry waste is sold to local ragpickers, thus forming part of informal economy.
NN Rudrapur	Partial source segregation of waste	ULB has achieved 70 % source segregation and is expecting reach 100% mark in near future.

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	Partially segregated waste transport.	Complete segregated waste transport would only be possible once 100% source segregation is achieved.
	No Linkage with authorized waste recyclers.	Recyclable dry waste is sold to local ragpickers, thus forming part of informal economy.
NPP Gadarpur	Partial Source segregation	ULB has achieved 70 % source segregation and is expecting reach 100% mark in near future.
	Partially segregated waste transport	Complete segregated waste transport would be possible once 100% source segregation is achieved.
	Non-availability of waste recovery facility	Dry waste is handled and segregated manually in the waste disposal site.
	No linkage established with authorized waste recyclers	Recyclable dry waste is sold to local ragpickers, thus forming part of informal economy.
NPP Bajpur	No source segregation	Mixed waste is being collected from each household in Nagar Palika.
	Combined waste transport	Waste is transported in combined form as source segregation is still not practised in Nagar Palika Bajpur.
	Non-availability of waste recovery facility	Dry waste is handled and segregated manually in the waste disposal site. Material recovery facility is under construction.
	No Linkage with authorized waste recyclers.	Recyclable dry waste is sold to local ragpickers, thus forming part of informal economy.
NPP Jaspur	No source segregation	Mixed waste is being collected from each household in Nagar Palika.
	Combined waste transport	Waste is transported in combined form as source segregating is still not practised in Nagar Palika Jaspur.
	Wet waste management.	Wet waste is not processed Nagar Palika Jaspur due to non-availability of composting pits or machinery.
	Non-availability of waste recovery facility.	Dry waste is handled and segregated manually in the waste disposal site.
	No Linkage with authorized waste recyclers.	Recyclable dry waste is sold to local ragpickers, thus forming part of informal economy.
NPP Kichha	Partial Source segregation	Source segregation is performed in 15 wards out of 20.
	Partially segregated waste transport	Waste is transported in combined from in some of the wards.(Particularly those with no source segregation).
	Non-availability of waste recovery facility	Dry waste is recovered manually by the firm handling waste management operations for the ULB.
	No Linkage with authorized waste recyclers.	Recyclable dry waste is sold to local ragpickers, thus forming part of informal economy.
	Lack of designated waste disposal land	Waste is disposed in some private land.
NPP Sitarganj	Partial Source segregation	Less than half of the population is practising segregation at source.
	Partially segregated waste transport	Complete segregated waste transport would be possible once 100% source segregation is achieved.
	Non-availability of waste recovery facility	• Dry waste is handled and segregated manually in the waste disposal site by an outsourcing form. Primarily, plastic waste is recovered. • Material recovery facility is under construction.
	No Linkage with authorized waste recyclers.	Recyclable dry waste is sold to local ragpickers, thus forming part of informal economy.
	Remediation of old dump site	One dump site comprising of almost 10000MT waste is yet to be remediated.
NPP Khatima	No estimated quantity of segregated dry and wet waste	Nagar Palika has not provided the rough estimate of the quantity of dry and wet waste generated.
	No source segregation of	Mixed waste is being collected from each household in Nagar

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	waste.	Palika
	Combined waste transport	Waste is transported in combined form as source segregation is still not practised in Nagar Palika Khatima.
	Wet waste management.	Wet waste is not processed Nagar Palika Khatima due to non-availability of composting pits or machinery.
	Non-availability of waste recovery facility	Dry waste is not processed in Nagar Palika.It is collected and dumped in the disposal site.
	No Linkage with authorized waste recyclers.	As the dry waste is not segregated , hence linkage seems redundant.
	Remediation of old dump site	One dump site comprising of almost 1500 MT waste is yet to be remediated.
NPP Mahuwa Khedaganj	Partial Source segregation	Almost half of the population is practising segregation at source.
	Partially segregated waste transport	Complete segregated waste transport would be possible once 100% source segregation is achieved.
	Non-availability of waste recovery facility	Waste recovery facility is under construction in Nagar Palika Mahuwa Khedaganj.
	No Linkage with authorized waste recyclers.	Plastic waste after segregation is sold to local ragpickers, thus forming part of informal economy.
NP Mahuwadabra	No source segregation of waste.	Mixed waste is being collected from each household in Nagar Palika.
	Combined waste transport	Waste is transported in combined form as source segregation is still not practised in Nagar Palika Mahuwadabra.
	Non-availability of waste recovery facility	• Dry waste, primarily plastic waste is recovered manually by the firm handling waste management operations for the ULB. • Waste recovery facility is under construction in Nagar Palika, Mahuwadabra.
	No Linkage with authorized waste recyclers.	Plastic waste after segregation is sold to local ragpickers, thus forming part of informal economy.
NP Sultanpur patti	Minimal source segregation	Source segregation is practised in only few wards.
	Partially Segregated waste transport	Waste is majorly transported in combined form as source segregation is minimal in Nagar Palika Sultanpur patti.
	Non-availability of waste recovery facility	Dry waste is handled and segregated manually in the waste disposal site by an outsourcing form. Primarily, plastic waste is recovered.
	No Linkage with authorized waste recyclers.	Plastic waste after segregation is sold to local ragpickers, thus forming part of informal economy.
	Lack of designated waste disposal land	Waste is disposed in some private land.
NP Khelakheda	Minimal source segregation	Source segregation is practised by only few households in 5 out of 9 wards.
	Partially segregated waste transport	Waste is majorly transported in combined form as source segregation is minimal in Nagar Palika Khelakheda
	Non-availability of waste recovery facility	Dry waste is handled and segregated manually in the waste disposal site by an outsourcing form. Primarily, plastic waste is recovered.
	Lack of designated waste disposal land	Waste is disposed in some private land.
NP Dineshpur	Partial source segregation of waste	At present, Nagar Palika is performing 70% source segregation.
	Partially segregated waste transport	Complete segregated waste transport would only be possible once 100% source segregation is achieved.
	Non-availability of waste recovery facility	Dry waste is handled and segregated manually in the waste disposal site by an outsourcing form. Primarily, plastic waste is recovered.
	No Linkage with authorized	Plastic waste after segregation is sold to local ragpickers, thus

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	waste recyclers.	forming part of informal economy.
NP Shaktigarh	Partial source segregation of waste	At present, Nagar Palika is performing 70% source segregation.
	Partially segregated waste transport	Complete segregated waste transport would only be possible once 100% source segregation is achieved.
	Non-availability of waste recovery facility	Dry waste is not processed in Nagar Palika. It is collected and dumped in the disposal site.
	No Linkage with authorized waste recyclers.	As the dry waste is not segregated , hence linkage seems redundant.
NP Nanakmatta	No estimated quantity of segregated dry and wet waste	Nagar Palika has not provided the rough estimate of the quantity of dry and wet waste generated.
	Minimal source segregation of waste.	Source segregation is practised by only few households
	Combined waste transport	Waste is majorly transported in combined form as source segregation is minimal in Nagar Palika Sultanpur patti.
	Non-availability of waste recovery facility	Dry waste is not processed in Nagar Palika.It is collected and dumped in the disposal site.
	No Linkage with authorized waste recyclers.	As the dry waste is not segregated , hence linkage seems redundant.
NP Gularbhoj	Partial source segregation of waste	At present, Nagar Palika is performing 70% source segregation covering 5 out of 7 wards.
	Partially segregated waste transport	Complete segregated waste transport would only be possible once 100% source segregation is achieved.
	Non-availability of waste recovery facility	Dry waste is not processed in Nagar Palika. It is collected and dumped in the trenching ground.
	No Linkage with authorized waste recyclers	As the dry waste is not segregated , hence linkage seems redundant.

Table 11. Proposed policies and budget requirement put forward by different stakeholders in the District

Proposed Policy	Stakeholders Responsible	Current status and Budget requirement
Integrated solid waste management project for Kashipur Cluster	• NN Kashipur • NPP Jaspur • NP Mahuwadabra	• A DPR has been approved for implementing Solid waste management(ISWM) at an estimating cost of INR 16.24 cr. • Three ULBs will manage their solid waste in a cluster based approach. • Components proposed for Kashipur cluster will include household bins for source segregation. Wheel barrows for sweepers, processing facility infrastructure, regional sanitary landfill at Rudrapur etc.
Integrated solid waste management project for Gadarpur Cluster	• NPP Gadarpur • NPP Bajpur • NP Khelakheda • NP Sultanpur patti	• A DPR has been approved for Solid waste management under Gadarpur cluster at an estimating cost of INR 13 cr. • Major works undertaken includes setting up of waste processing plant in village Majra hasan with an estimated area of around 8.77 ha. • Other works includes construction of Material recovery facility, composting sheds, sanitary landfill etc. • Development of monograph/templates on solid waste management for local people improving the waste

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		management skills.
*Integrated waste management under Haldwani Cluster	NN Rudrapur NPP Kichha	• Proposed works includes transportation vehicles, construction of a CBG (Compressed biogas plant), remediation of legacy waste in Pahadganj area, scientific processing of dry waste etc. • A land proposal has been sent to DM office for construction of material recovery facility. • NN Rudrapur and NPP Kichha are part of Haldwani cluster for effective dry waste management.
Revamping solid waste management in Nagar Palika Parishad Kichha	NPP Sitarganj	• A DPR with estimated cost of INR 4.80 cr. has been approved for improving solid waste management. • Development works will include infrastructure for waste transportation, boundary wall for trenching ground, construction of composting pits etc.
Revamping solid waste management in Nagar Palika Parishad Khatima	NPP Khatima	• A DPR with estimated cost of INR6.5 cr. has been approved for improving solid waste management. • Development work will include construction of material recovery facility, composting pits, trenching ground etc.
Revamping solid waste management in Nagar Palika Parishad Mahuwa kheraganj	NPP Mahuwa kheraganj	• A DPR with estimated cost of INR1.8 cr. has been approved for improving solid waste management. • Development works includes machinery for Material recovery facility, transportation vehicles etc.
Revamping solid waste management in Nagar Panchayat Shaktigarh	NP Shaktigarh	• A DPR with estimated cost of INR 44 lakhs has been approved for improving solid waste management. • Development works will include purchase of transportation vehicles, construction of trenching ground etc.
Revamping solid waste management in Nagar Panchayat Nanakmatta	NP Nanakmatta	• A DPR with estimated cost of INR 2.37 cr. has been approved for improving solid waste management. • Development works will include purchase of transportation vehicles, construction of trenching ground and other civil works.

**Haldwani cluster also includes ULBs namely Haldwani, Nainital, Lal Kuan, Bhawali, Bhimtal which comes under Nainital district.*

Vegetation suitable for rehabilitation of dumping sites

Phytoremediation, collectively referring to all plant based technologies, uses green plants to remediate contaminated sites (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 (Table 12). 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 cover that is deep and as favourable to root growth as is necessary to achieve desired plant performance (Nagendran et al, 2006). In this context, locally available species could be hardened and resistant in reclaiming the waste dump problem (Table 12).

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Table 12. Vegetation suitable for rehabilitation of dump sites.

Botanical Name	Local and English Name	Assimilating capacity	Altitude (m)	Site/ Location
Mangifera indica	Mango	Absorb dust particles	100-1200	Shukla, et al, 2019
Populus nigra L.	Popular	Accumulation of Cd, Pb, As, and Ni	100-1800	Houda et al, 2016
Populus alba L.	Black popular	Accumulation of Cd and Pb	100-1400	Houda et al, 2016
Cassia fistula L.	Amaltas	Absorbs Arsenic and Fluoride from wastewater	100-1500	Houda et al, 2016
Delonix regia (Bojer ex Hook.) Raf.	Gulmohar	Accumulation of (Cd, Pb, Zn and Cu)	250-1250	Ukpebor et al, 2010
Cynodon dactylon (L.) Persoon	Doob	Absorbs Arsenic and Fluoride from wastewater	400-2500	Kumar et al., 2011

Rural Solid Waste Management

The domestic waste generated in rural households of India is increasingly becoming an issue of serious concern. As per reported by Ministry of Drinking Water and Sanitation (MDWS), about 0.3 to 0.4 million metric tonnes of solid waste is generated in rural India every day (Anonymous, 2016). With the objective of achieving Open Defecation Free (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, because of its less generation rate as compared to urban areas.

Current status of Rural Waste Management in India

Rural waste has distinct characteristics as compared to urban waste in terms of composition and its types. Here, majority of the waste belongs to biodegradable category. In view of management, the rural areas are yet to formalise their solid waste management operations, hence it cannot be easily quantified.

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

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Projected Population and Waste generation in U.S. Nagar district

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

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

- Arithmetic increase method is used for the decadal population forecast, hence the rate of change of population with time is assumed constant
- In view of changing waste paradigm and floating population, 1.5% yearly growth in per capita waste generation is assumed.
- Analysis includes population and waste generation estimations for only urban local bodies and does not include peri-urban and rural areas (Table 13 and 14; Fig.3 and 4)).

Table 13. Projected population and waste generation

ULB	**Projected Population**			**Existing/Projected Waste Generation (MTPD)**		
	2021	**2031**	**2041**	**2021**	**2031**	**2041**
Nagar Nigam Kashipur	150279	178935	207591	52.00	71.20	95.00
Nagar Nigam Rudrapur	220432	286310	352188	65.00	97.09	137.34
Nagar Palika Parishad Gadarpur	24957	30613	36269	8.00	11.28	15.38
Nagar Palika Parishad Bajpur	29256	32988	36720	12.00	15.56	19.92
Nagar Palika Parishad Jaspur	62109	73695	85281	25.00	34.11	45.40
Nagar Palika Parishad Kichha	53427	64889	76351	25.00	34.92	47.25
Nagar Palika Parishad Sitarganj	37903	45841	53779	19.00	26.43	35.65
Nagar Palika Parishad Khatima	15851	16609	17367	18.00	21.69	26.08
Nagar Palika Parishad Mahuwa Khedaganj	16310	20036	23762	2.00	2.83	3.85
Nagar Panchayat Mahuwadabra	8549	9772	10995	1.8	2.37	3.06
Nagar Panchayat Sultanpur patti	12048	14215	16382	4.00	5.43	7.19
Nagar Panchayat Khelakheda	14076	17223	20370	4.3	6.05	8.23
Nagar Panchayat Dineshpur	13830	16317	18804	5.5	7.46	9.89
Nagar Panchayat Shaktigarh	7842	9375	10908	1.2	1.65	2.21
Total				**242.8**	**338.07**	**456.45**

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Table 14. Projected decadal change in solid waste generation

Name of ULB	%age Rate of Growth (2021-2031)	% age Rate of Growth (2031-2041)
Nagar Nigam Kashipur	3.69	3.34
Nagar Nigam Rudrapur	4.94	4.15
Nagar Palika Parishad Gadarpur	4.11	3.62
Nagar Palika Parishad Bajpur	2.97	2.80
Nagar Palika Parishad Jaspur	3.65	3.31
Nagar Palika Parishad Kichha	3.97	3.53
Nagar Palika Parishad Sitarganj	3.91	3.49
Nagar Palika Parishad Khatima	2.05	2.02
Nagar Palika Parishad Mahuwa Khedaganj	4.13	3.64
Nagar Panchayat Mahuwadabra	3.15	2.94
Nagar Panchayat Sultanpur patti	3.57	3.25
Nagar Panchayat Khelakheda	4.07	3.60
Nagar Panchayat Dineshpur	3.57	3.25
Nagar Panchayat Shaktigarh	3.75	3.38

Inferences drawn from the projection of waste

- Solid waste generation in the district is expected to rise in coming decades and would cross 300 MTPD by 2031.
- Nagar Nigam Rudrapur and Nagar Nigam Kashipur contributes for more than half of the solid waste generated in the district.
- 3 to 4 % growth rate in solid waste generation is expected in coming decades.
- Increased urbanization will change the waste composition in the district. The quantity of wet waste may decrease; however, there would be increase in e-waste, hazardous waste generation, plastic waste etc.

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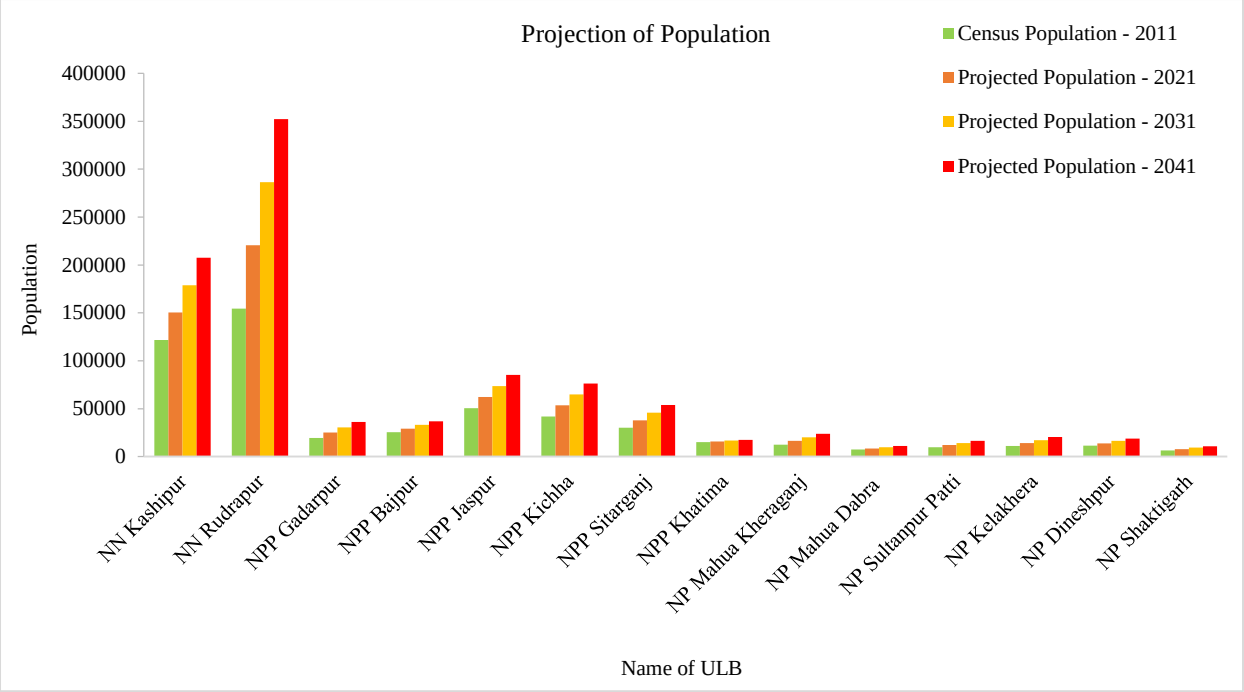

Fig. 3. Geographical representation of projected population

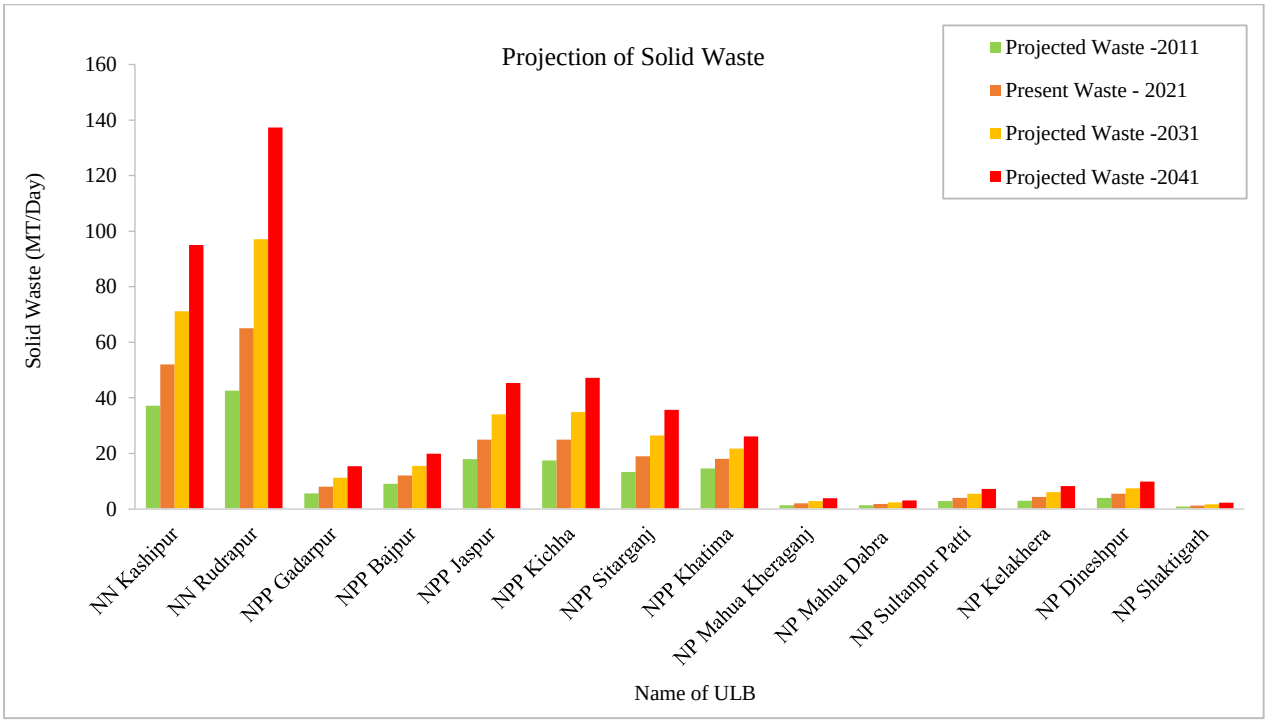

Fig. 4. Projected solid waste generation

BIO MEDICAL WASTE MANAGEMENT

According to latest biomedical waste management rules (published in 2016 and amended in 2019), biomedical waste is defined as such waste that is generated during diagnosis, treatment or immunization of human beings or animals, or in research activities pertaining thereto or in the production or testing of biological experiments. The fact sheet of WHO states that 20% of the total waste generated by health care activities is hazardous. All the biomedical waste generated is essential to be properly collected, segregated, stored, transported, treated and disposed of in a safe manner to prevent spreading infectious diseases. The health system of Uttarakhand constitutes a large network of health care facilities based on three-tier system that comprises of district level health care facilities (District hospitals, base hospitals, etc.), community health care centres (CHCs), and primary health care centres (PHCs). Biomedical waste generation has shown a wide variation in Uttarkhand due to its typical physiographical conditions and changing density of population. Handling and disposal of biomedical waste is done as per BMW rules, 2016 (Fig. 5).

(Source: CPCB 2020)

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

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Importance of Biomedical Waste Management in the Wake of Pandemic

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

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

Biomedical Waste Management in US Nagar

Sufficient government and private healthcare facilities are available in Udham Singh Nagar, which consists of bedded and non-bedded hospitals, veterinary hospitals, pathology labs, clinics, blood banks etc. (Table 15). Maximum healthcare facilities have established linkage with a Common Biomedical waste treatment facility (CBMWTF) for proper treatment and disposal.

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

S. No.	Parameter	Outcome	
1.	Health-care facilities in the district	**Facility**	**Numbers**
		Govt. Bedded HCFs	44
		Private bedded HCFs	176
		Govt. Non-bedded HCFs	01
		Private Non-bedded HCFs	138
		Veterinary Hospitals	23
		Pathology Labs	65
		Dental Clinics	45
		Blood Banks	02
		Others (Ayurvedic HCFs)	22
		Total	**516**
2.	Number of health care facility authorized by SPCB/PCC	***Facility***	***Numbers***
		Govt. Bedded HCFs	30
		Private bedded HCFs	130
		Govt. Non-bedded HCFs	01
		Private Non-bedded HCFs	125
		Govt. Veterinary HCFs	21
		Pathology labs	34
		Private dental clinics	16
		Blood Bank	02
		Other (Ayurvedic HCFs)	18

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		Total	**377**
3.	Linkage with Common Bio-medical Waste Treatment Facility (CBMWTF)	377Health care facilities are linked to Global Environmental Solution (GES). However, Partially some ULBs has established linkage with CBWTF for biomedical waste management.	
4.	Pre-segregation	Partially pre-segregation of the biomedical waste in the district.	
5.	Capacity of Common Bio-medical Waste Treatment Facility (CBMWTF)	GES receives Bio medical waste of entire Kumaon Region; therefore, capacity is assessed with respect to total waste received from other districts also. Incineration capacity- (1600 kg/day) and (100 kg/hr) Autoclave (10800 kg/day)/ 450 kg/hr	
6.	Captive disposal facilities	NIL	

(*Sources: Health Department of US Nagar 2021, UKPCB, 2021*)

Prevailing Bio-Medical Waste Management in the District

- Presently, 516 HCFs have been inventorized by the State Pollution Control Board (SPCB), out of which 377 HCFs have valid authorization /consent to operate. Notice has been issued to rest of HCFs. Before issuing, it is mandatory to get membership of CBWTF in order to ensure proper collection of bio-medical waste generated by HCFs
- GPS system enabled vehicles are used in order to ensure proper tracking of waste.
- Routine inspection of CBMWTF is being done by the head office and regional office.

Current Status and proposed policies for Biomedical waste management in Udham Singh Nagar

Unlike in other districts, the biomedical waste is segregated in healthcare facilities according to latest Bio-medical waste management rules, 2016. Waste is segregated into different categories according to composition and then lifted to CBMWTF (Table 16).

Table 16. Current status of biomedical waste management

S. No.	Action areas	Outcomes	
1.	Composition of Bio-medical waste	Bio-medical waste generally comprises of Discarded blood, used bandages, Used dressings, discarded Gloves and other medical supplies.	
		Category	**Percentage (%)**
		Yellow category	26.64
		Red category	46.44
		White/Blue category	26.92
2.	Daily Bio-medical waste lifting by Common Bio-medical waste treatment facility (CBMWTF)	**Category**	**Kg/day**
		Yellow category	108.24
		Red category	188.97
		White/Blue category	109.62
		Total	**406.83**

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4.	Pre segregation of waste by Health care facilities.	Partial segregation
5.	Segregation of BMW as per guidelines of BMW rules, 2016	In Practice
6.	Tracking of biomedical waste (Implementation of bar code system for tracking)	Partially

Source: UKPCB, 2020

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CONSTRUCTION & DEMOLITION WASTE MANAGEMENT

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

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

Present state of affairs

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

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Table 17. Characteristics of C&D Waste in India

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

(Source: District Administration, 2020)

Table 18. Thumb rule for Estimation of C&D waste generation for India

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

Present infrastructure within the state

- Currently, no treatment facility is available in the state for processing the C&D waste.
- Rapid Urbanization has increased construction activities in plain areas, but scientific management C&D waste is hard to find.
- As the management of C&D waste is not done in the state, so it is not possible to assess the total amount of waste generated.

C&D Waste Management in US Nagar district

Construction and demolition waste is not yet quantified in the district pertaining to the fact that its quantity is assumed to be nominal (Table19). However, with rapid urbanization, construction activities will rise, hence some strategy is required for scientific management of C&D waste. This may include establishment of dumping sites, framing of byelaws etc. (Table 20).

Table 19. 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 collection of C&D waste is not initiated. However, its 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.

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3.	Establishment of disposal sites /Dumping zones	Not initiated
4.	Establishment of linkage with any C&D waste recycling facility	There is no C&D waste treatment facility in the district. Moreover, none of the ULBs has linkage with any common C&D waste treatment facility.

Table 20. Gaps Identified in the management of C&D waste

S. No.	Observed shortcomings	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 / disposal sites / dumping zones	District authority claims of using all the C&D waste forfilling low lying areas and development works near the construction site.
3.	Implementation of by-laws for C&D waste management	C&D waste is not streamlined in current waste management operations. Hence by-laws are not framed yet.

C&D Waste Management in Rural Areas

In the rural areas of US Nagar district, construction work is observed to be 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 either in filling the plinth and trenches or many times used in the low-lying areas. Stones obtained from the hill slopes are used in masonry work. There is an issue of improper dumping of muck dumping along the river banks or seasonal streams (khads) or construction of roads. These issues need to be addressed within a strategy for managing construction and demolition waste.

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HAZARDOUS WASTE MANAGEMENT

Hazardous Waste is any waste which because of characteristics such as physical, chemical, biological, reactive, toxic, flammable, explosive or corrosive, causes danger or is likely to cause danger to health or environment (whether alone or in contact with other wastes or substances). State Pollution control board (SPCB) is responsible for tabulation of hazardous waste generating units and quantification of waste generated in respective state. 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.

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 (Table 21).
- The rules were amended on March 2019 keeping in consideration the ease of doing business, boosting make in India initiative by simplifying the procedures, while at the same time upholding the principles of sustainable development.
- According to CPCB Report 2019-20, there are 69,308 hazardous waste generating units in India having authorized annual capacity to generate about 39.46 million MT of hazardous waste. However, about 8.78 million MT hazardous waste was generated during 2019-20, based on the annual returns submitted by such units (CPCB, 2020).

Table 21. Hazardous Waste generation in India

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

(Source: CPCB, 2020)

Hazardous waste management in U.S. Nagar District

Industrial processes are the main source of hazardous waste in the district. Much of the hazardous waste generated is quantifiable and is managed according to Hazardous and other wastes (Management and Transboundary Movement) rules, 2016 (Table 22). TSDF is also available in the district, which facilitates scientific management of hazardous waste in Global Environmental Solution Ltd, Gadarpur, Udham Singh Nagar (Table23). Some hazardous waste contaminated sites have been identified in Kashipur and Pantnagar. However, hazardous waste generated in

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domestic households along with verification of records with respect to generators needs consideration (Table 25).

Table 22. Inventory of Hazardous waste in Udham Singh Nagar

S. No.	Parameter	Present status				
1.	Quantity of hazardous waste generated in the district (MT/Annum)	**Land fillable**	**Incinerable**	**Recyclable**	**Utilizable**	**Total**
		5928	4210	40978	2985	54101
2.	Quantity of hazardous waste imported from other state/UTs (MT/Annum)	1427.49	2161.91	13739.9	605.79	17935.1
3.	Quantity of Waste Processed (MT/Year) (Listed under Schedule -IV Hazardous waste)	Recycled				14145.72
		Utilized (Co-processed in Cement Plant)				560.7
		Disposed in secured landfill				1344.49
		Disposed through incinerator				2178.51
3.	Total number of units authorised under Hazardous Waste Management Rules, 2016	1334 (Each industry has display board of Hazardous Waste generation in front of gate)				
4.	Number of Hazardous waste Dumpsite	None				

Table 23. Current status related to Hazardous waste management

S. No.	Action Areas	Outcome And Remarks
1.	Method of Disposal	Incinerable and land fillable waste is disposed through Common Treatment, Storage and Disposal Facility (TSDF) and recyclable hazardous waste is being recycled through registered recyclers located within the state and outside the state.
1.	No. of captive / common TSDF (Treatment storage and disposal facilities) in the district.	Sent to other district in the state (Global Environmental Solution Ltd.) Gadarpur.
2.	Industries Linkage with common TSDF	1051 Units
3.	Number of industries authorized by SPCB	1051
4.	Number of ULBs linked with common TSDFs	Not Initiated
5.	Contaminated sites/probable contaminated sites within the district	Two sites are identified in the US Nagar: 1. DSM Sugar Factory Field Kashipur 2. Village Gangapur Patia Pantnagar
6.	Regulation of industries & facilities generating Hazardous waste	Industries generating hazardous waste are regularly monitored by state pollution control board.
	Compliance with Hazardous Waste and Management Rules,2016	All the industries adhere to the Hazardous waste management rules, 2016. Following are some notable areas where compliance is done: • Annual inventory submitted by the units with respect to quantity of hazardous waste generated, daily records etc. • Directory of Hazardous waste generating units in service sector and domestic hazardous waste. • Hazardous waste disposed/stored by generator and received by common Treatment, storage and disposal

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		facility (TSDF). • Display board, adequate collection and storage facility within generator premises.

Table 24. Gap identification

Observed Shortcomings	Remarks
Verification of record with respect to generation/storage and disposal by the generator.	Random verification of industries generating hazardous waste with respect to the manufacturing process is required.
Record of Hazardous waste generated in service sector especially in the Automobile sector.	Identification of hazardous waste generating units in the service sector, physical verification of quantity and type of waste is required.
Estimation of quantity of hazardous waste within waste generator premises.	Special/technical support in the field of hazardous waste management is required.
Lack of Instrumentation and additional infrastructure.	Technical support in terms of following points is required. • Identification of Probable contaminated site due to improper handling of hazardous waste. • Reclamation of contaminated sites.

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ELECTRONIC WASTE MANAGEMENT

The Discarded and end-of-life electronics products ranging from computers, equipment used in Information and Communication technology (ICT), home appliances, audio and video products and all of their peripherals are known as Electronic waste (E-waste). Computer devices contributes to almost two third of electronic waste in India (Table 25). 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 (EEMI, 2018).

Government of India has notified E-Waste Management Rules 2016, which are expanded to manufacturer, dealer, re-furbisher and Producer Responsibility Organization (PRO) of components, consumables, spares and parts of Electronics and Electrical Equipment (EEE) in addition to equipment as listed in Schedule I appended with the rules. Moreover, Compact Fluorescent Lamps (CFL) and other mercury containing lamps are also brought under the provisions of these Rules**.** Amendments were further made on March 2019 with the objective of channelizing the E-waste generated in the country towards dismantlers and recyclers in order to formalise the e-waste recycling sector.

Table 25. Bifurcation of E-waste based on electronic appliances

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

(Source: ASSOCHAM, 2020)

Worldwide Scenario

- Electronics and Electrical Equipment (EEE) are manufactured and disposed worldwide. In 2016, 44.7 Million Metric Tons (MMT) of e-waste was generated worldwide *(equivalent to 6.1kg/inhabitant).* Following the current growth rate of rising e-waste, it is estimated that by 2021, quantity has already risen to 52.2 Million Metric Tons or 6.8 kg/inhabitant.

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- 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.

E-waste Management in US Nagar district

The quantification of e-waste is not yet initiated in the district. However, the administration has managed linkage with authorised recyclers to channelize the e-waste. (Table 26). Primary segregation of e-waste is still a distant dream due to lack of awareness and e-waste collection centres (Table 27).

Table 26. Current standpoints regarding E-waste generation and collection

S. No.	Parameter	Outcome & Remarks	
1.	Quantity of e-waste generated per annum (MT)*(As per State pollution control board)*	Uttarakhand	*16260*
		US Nagar	*Not Estimated*
2.	Toll-free number in the district for the citizens to deposit e-waste	Not yet initiated in the district.	
3.	Collection centre established by ULBs in the district	• At present, there are no collection centres established by any of the ULBs or the district administration.	
4.	Number of authorized e-waste Recyclers / dismantlers in the state	Currently, five authorized recyclers/dismantlers are available in the district namely: • *Attero Recycling Pvt. Ltd. Raipur, Bhagwanpur* • *Bharat Oil & Waste Management, Mukhimpur, Laksar*	

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		• *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 ULB in the district has established linkage with authorised e-waste recycling facility. However, district administration have linkage with the authorised e-waste recycling facility to deposit e-waste generated from the government offices.
6.	Control over illegal trading or processing of e-waste in the district	Controlled

Table 27. Gap identification in e-waste management

S. No.	Gaps identified	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 is not being sent for recycling. There is no facility in the district to deposit or to collect e-waste. • As there is no facility of toll free number to deposit or to collect e-waste in the district. So all the e-waste generated from the residential areas is mixed with municipal solid waste and thus could not be 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 linkages with recyclers / dismantlers.

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POLLUTED RIVER STRETCHESIN US NAGAR

The polluted locations in a continuous sequence are defined as polluted river stretches and are categorized in five priority classes based on BOD concentration (Table 28). The Central Pollution Control Board (CPCB) in 2018 identified 351 Polluted river stretches in India. The national-level assessment of water quality for identification of Polluted river stretches has found that there are 31 states and Union territories having rivers and streams not meeting water quality criteria. Currently, 9 rivers are monitored in Uttarakhand at 28 different locations. It is prerequisite to maintain water quality in accordance to the criteria set out as per designated best use (Table29).

Table 28. Criteria for Prioritization

Priority area	**BOD Level (mg/l)**
Priority I	>30 mg/l
Priority II	20-30 mg/l
Priority III	10-20 mg/l
Priority IV	6-10 mg/l
Priority V	3-6 mg/l

(Sources UKPCB, 2020)

Table 29. Water Quality standards for different purposes

Designated Best Use	**Class**	**Criteria**	
		Parameter	**Prescribed value**
Drinking water source without Conventional treatment but after disinfection	A	pH	6.5- 8.5
		DO	6 mg/l or more
		BOD	2 mg/l or less
		Total Coliforms (MPN/100ml)	50 or less
Outdoor Bathing (Organized)	B	pH	6.5-8.5
		DO	5mg/l or more
		BOD	3 mg/l or less
		Total Coliforms	500 or less
		(MPN/100ml)	
Drinking water source after conventional treatment and disinfection	C	pH	6-9
		DO	4 mg/l or more
		BOD	3mg/l or less
		Total Coliforms (MPN/100ml)	5000 or less
Propagation of Wild life and Fisheries	D	pH	6.5-8.5
		DO	4gm/l or more
		BOD	2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste Disposal.	E	pH	6.0-8.5
		Electrical Conductivity	2250
		Sodium Absorption ratio	Max.26
		Boron Max.	2mg/l
	Below -E	Not meeting any of the above standards	

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Polluter stretches in US Nagar

As much as seven polluter stretches have been identified in Udham Singh Nagar district with priority level varying from **(I) to (IV)** (Table 30). Kashipur, Bajpur, Rudrapur, Sitarganj and Sultanpur are major towns that lie in the vicinity of these polluted stretches. Effluent from industries, sewage generated from households and dumping of solid waste in river catchment have been major sources of water pollution in these stretches of rivers (Table 31).

Table 30. River Polluter Stretches in Udham Singh Nagar

S. No	River Name	Stretch Identified	Major Cities/towns	Length of Stretch (Km)	Priority class
1.	Bhela	Kashipur to Rajpura Tanda	Kashipur	14	**(I)**
2.	Dhela	Kashipur to Garhuwala (Thakurdwara)	Kashipur,Thakurdwara	14	**(I)**
3.	Kichha	Drains of Kiccha Gola river	Kichha, Lalkuan	06	**(II)**
4.	Kalyani	Drains of Rudrapur	Pantnagar, Rudrapur, Sitarganj	11.5	**(III)**
5.	Nandour/Kailash	Along Sitarganj	Sitarganj	-	**(IV)**
6.	Pilakhar	In the vicinity of Rudrapur	Rudrapur, Bazpur	-	**(IV)**
7.	Kosi	Sultanpur to Pattikalan	Sultanpur	06	**(IV)**

(Sources UKPCB, 2020)

Table 31. Identification of sources of Pollution in the polluter stretches

Potential source of pollution	Remarks		
Industrial pollution	River Stretch	Number of GPIs(Grossly polluting industries) in polluter stretch or entire catchment of river	Number of Industrial drains meeting the river
	River Bhela (Kashipur to Rajpura Tanda	08 (Two of them are maintaining Zero Liquid Discharge)	03
	River Dhela (Kashipur to Garhuwala)	14	04
	Kichha (Drains of Kiccha river Gola)	04	01
	Kalyani (Drains of Rudrapur)	03	-
	Nandhour (Along Sitraganj)	02	-
	Pilakhar (In the vicinity of Rudrapur)	03 (one unit not operational)	-
	Kosi (Sultanpur to Pattikalan)	02	01

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	Individual effluent treatment plant and Common Effluent Treatment Plant (CETP) are monitored by Uttarakhand Pollution Control Board (UKPCB)		
	Industrial hazardous waste mainly used oil/Contaminated barrels are being recycled through registered recyclers. Rest is either disposed through Treatment, Storage and Disposal Facility (TSDF) or incinerated.		
Domestic Sewage	**River Stretch**		**Number of sewage drains meeting the river**
	River Bhela (Kashipur to Rajpura Tanda		02
	River Dhela (Kashipur to Garhuwala)		06
	Kichha (Drains of Kiccha Gola river)		06
	Kalyani (Drains of Rudrapur)		22
	Nandhour/Kailash (Along Sitraganj)		01
	Pilakhar (In the vicinity of Rudrapur)		01
	Kosi (Sultanpur to Pattikalan)		01
	All the cities/towns in the periphery of these rivers have no sewage treatment plant for waste water management.		
Solid waste	**Name of the river**	**Major Cities/Towns in the vicinity of the river**	**Remarks**
	Bhela	Kashipur	Illegal disposal of solid waste along the river banks and flood plain zones.
	Dhela	Kashipur	
	Kichha	Nagar Palika Kichha	
	Kalyani	Rudrapur, Pantnagar	
	Nandhour/Kailash	Sitarganj	
	Pilakhar	Bazpur	
	Kosi	Sultanpur Patti	

Water Quality Characteristics of Polluted river stretches at Different Monitoring Stations

River Bhela

Originating from the agriculture fields, Bhela is small spring-fed river and is a tributary of river Kosi. The watershed of Bhela river lies in the Ramnagar and Bajpur road areas of Kashipur. This is also the region which comprises of industries that discharge their effluent, directly or indirectly into the river. Constant efforts are being made to improve the water quality of the river. Currently, it has been noted that the goals can be met for Class 'E' (i.e. for irrigation, industrial cooling and controlled water disposal).

Based on monitored data for the year 2016 and 2017, Bhela river stretch from Kashipur to Rajpura Tanda (approx. 14 km) has been declared as polluted river stretch of priority (I) by Central Control Board(CPCB). Water quality is being monitored in two locations on the upstream and downstream of Kashipur town (Table 32). The river is still not found suitable for drinking or

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bathing purpose as the BOD levels have been breached almost every year. However, no groundwater contamination is reported in these areas.

Table 32. Water quality characteristics of River Bhella (2017-2021)

Year	Name of Monitoring location	pH	BOD (mg/l)	COD (mg/L)	DO (mg/l)	Conductivity (umhos/cm)	TDS (mg/l)
2021	Ramnagar Road US Nagar	6.20	7.44	32.80	3.78	334.40	228.00
	Lohia Bridge Kashipur US Nagar	6.78	26.80	122.00	1.12	672.00	445.80
2020	Ramnagar Road US Nagar	7.43	5.12	25.67	5.21	279.58	189.75
	Lohia Bridge Kashipur US Nagar	7.03	22.25	103.42	1.54	541.50	360.17
2019	Ramnagar Road US Nagar	7.31	3.61	23.62	4.86	267.80	161.80
	Lohia Bridge Kashipur US Nagar	6.97	39.67	115.17	0.58	489.42	315.42
2018	Ramnagar Road US Nagar	7.21	4.70	14.62	6.48	240.00	160.80
	Lohia Bridge Kashipur US Nagar	7.34	38.67	116.00	1.25	551.67	362.33
2017	Ramnagar Road US Nagar	7.25	4.31	17.16	6.47	222.00	156.33
	Lohia Bridge Kashipur US Nagar	7.11	35.00	151.80	0.50	571.00	351.20

(Sources UKPCB, 2020)

River Dhela

Originating from the Ramnagar forest area of Nainital district, Dhela is a tributary of Ramganga river. It is diverted to Tumaria dam, from where the water is channelized for irrigation purpose. Dhela is a seasonal stream and remains dry in the lean season (No natural discharge is observed). The river gets contaminated from the industries (majorly pulp and paper industries) located in the Moradabad and Aliganj roads leading to Kashipur.

Based on monitored data for the year 2016 and 2017, River Dhela from Kashipur to Gheruwala Thakurdwara (approx. 14km) has been declared as polluted river stretch of priority (I) by Central Pollution Control Board(CPCB). Water quality is being monitored in two locations on the upstream (at Manpur bridge) and downstream (at Bhojpur) of Kashipur town (Table 33). Water quality is still not found adequate for drinking or bathing purpose as the BOD levels have been breached most of the time from the past three years. However, groundwater contamination is reported in these areas.

Table 33. Water quality characteristics of River Dhela (2017-2021)

Year	Name of Monitoring location	pH	BOD (mg/l)	COD (mg/l)	DO (mg/l)	Conductivity (umhos/cm)	TDS (mg/l)
2021	Dhella River at Kashipur Moradabad Road Bridge US Nagar	7.63	12.67	45.33	4.67	546.33	381.33
	Dhella River D/S at Thakurdwara, US Nagar	7.64	43.00	134.60	0.48	930.60	634.00
2020	Dhella River at Kashipur Moradabad Road	7.69	6.56	26.83	5.37	347.08	228.42

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	Bridge US Nagar						
	Dhella River D/S at Thakurdwara, US Nagar	7.31	15.80	71.89	1.77	508.88	350.25
2019	Dhella River at Kashipur Moradabad Road Bridge US Nagar	7.36	6.92	25.90	5.54	290.70	164.30
	Dhella River D/S at Thakurdwara, US Nagar	7.45	19.06	68.10	1.56	482.80	281.10
2018	Dhella River at Kashipur Moradabad Road Bridge US Nagar	7.29	7.40	23.00	5.75	280.00	182.13
	Dhella River D/S at Thakurdwara, US Nagar	7.23	21.78	75.11	2.60	457.78	317.56
2017	Dhella River at Kashipur Moradabad Road Bridge US Nagar	7.41	9.14	30.29	5.54	261.67	160.00
	Dhella River D/S at Thakurdwara, US Nagar	7.28	25.33	85.33	1.99	625.56	386.56

(Source: UKPCB, 2020)

River Kichha

Kichha, also known as Gola river originates in lesser Himalayas of Kumaon hills and flows through Kathgodam, Haldwani and Kichha town. It is a tributary of Ramganga river and is almost dry except in the monsoon season. Industrial wastewater from paper and pulp industries (in Lalkuan) and municipal drains are major reason for water contamination in the river.

Based on monitored data for the year 2016 and 2017, River Kichha along the Kichha town (approximately 6km) has been declared as polluted river stretch of priority (II) by Central Pollution Control Board(CPCB). Water quality is being monitored in the downstream of Kichha town (near bypass bridge (Table 34) and is still not found suitable for drinking or outdoor bathing purpose. However, based on past two years' data, the water quality has shown some improvement and can be designated as a polluted stretch of priority(IV) or (V).

Table 34. Water quality characteristics of River Kichha (2017-2021)

Year	Monitoring location	pH	BOD (mg/L)	COD (mg/L)	DO (mg/L)	Conductivity (umhos/cm)	TDS (mg/L)
2021	Kicha (U/S Nagarbhalla, Kashipur, US Nagar	8.02	4.06	23.00	7.62	921.60	659.40
2020	Kicha (U/S Nagarbhalla, Kashipur, US Nagar	7.79	6.65	41.80	4.28	508.92	341.58
2019	Kicha (U/S Nagarbhalla, Kashipur, US Nagar	7.34	6.13	32.67	4.57	503.25	342.92
2018	Kicha (U/S Nagarbhalla, Kashipur, US Nagar	7.65	16.53	62.67	3.95	543.33	353.92
2017	Kicha (U/S Nagarbhalla, Kashipur, US Nagar	7.66	8.62	42.50	4.80	618.50	408.67

(Sources UKPCB, 2020)

River Kalyani

Originating from Tanda forest area of district Nainital, Kalyani is a spring fed river which passes through the agriculture fields of Pantnagar. It is a non-perennial river with minimum flow (almost

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dry) during non-monsoon months. River kalyani receives treated waste water from CETP, IIE Pantnagar and other individual industrial units. Moreover, waste water from municipal drains (Residential areas) of Rudrapur is also discharged in the river.

Kalyani river, along IIE Pantnagar and downstream of Pantnagar (Approx. 11.5 km length) has been declared as Polluted river stretch of priority (III) by Central Pollution Control Board(CPCB). Water quality is being monitored in the upstream and downstream of Pantnagar industrial area. (Table 35). Water quality has not shown much improvement over the past two years as the BOD concentrations have exceeded the desired levels. So far, no groundwater contamination is reported in these regions.

Table 35. Water quality characteristics of River Kalyani (2017-2021)

Year	Name of Monitoring location	pH	BOD (mg/l)	COD (mg/l)	DO (mg/l)	Conductivity (umhos/cm)	TDS (mg/l)
2021	Kalyani River at U/S Pantnagar Industrial Area, US Nagar	7.42	6.88	30.00	5.40	655.20	440.20
	Kalyani River at D/S Pantnagar Industrial Area, US Nagar	8.04	26.20	134.00	0.48	1096.00	758.20
2020	Kalyani River at U/S Pantnagar Industrial Area, US Nagar	7.52	5.66	23.58	4.68	387.17	246.25
	Kalyani River at D/S Pantnagar Industrial Area, US Nagar	7.38	11.02	49.92	2.84	559.50	334.08
2019	Kalyani River at U/S Pantnagar Industrial Area, US Nagar	7.41	5.58	22.75	5.25	419.50	249.83
	Kalyani River at D/S Pantnagar Industrial Area, US Nagar	7.08	11.45	39.50	3.53	500.42	307.33
2018	Kalyani River at U/S Pantnagar Industrial Area, US Nagar	7.36	3.60	16.22	7.22	415.56	267.33
	Kalyani River at D/S Pantnagar Industrial Area, US Nagar	7.20	34.52	129.83	2.53	525.00	357.42
2017	Kalyani River at U/S Pantnagar Industrial Area, US Nagar	7.46	2.25	15.53	7.80	415.50	269.75
	Kalyani River at D/S Pantnagar Industrial Area, US Nagar	7.60	7.09	36.00	5.07	573.20	360.42

(Sources UKPCB, 2020)

River Nandhor

River Nandhor, also known as Kailash originates from Pangoot in Nainital Forest area and flows downstream along the Eldeco SIDCUL Industrial Park (ESIPL) and Sitarganj town. As much as 96 industries are located in ESIPL. The treated waste water from CETP (in ESIPL) is disposed to the river through land disposal (Karnal technology) and the overflow discharges into Baigul canal.

Nandhor/Kailash is a spring fed river and has no direct source of industrial waste water before ESIPL. It has been declared a polluted river stretch of priority (IV) by Central Pollution Control Board (CPCB). Hence, Water quality is being monitored in the upstream and downstream Sitarganj Industrial area (Table 36). The water quality has shown some improvement in past two

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years as the BOD levels have been decreasing rapidly. So far, no groundwater contamination is reported in these regions.

Table 36. Water quality characteristics of River Nandhor (2017-2021)

Year	Name of Monitoring location	pH	BOD (mg/l)	COD (mg/l)	DO (mg/L)	Conductivity (umhos/cm)	TDS (mg/l)
2021	Nanduar River Sitarganj Industrial Area US Nagar	7.20	3.30	15.00	7.30	473.00	310.00
	Nanduar River D/S Sitarganj Industrial Area, US Nagar	7.56	3.60	14.40	7.54	455.80	297.20
2020	Nanduar River Sitarganj Industrial Area US Nagar	7.65	6.85	28.00	5.68	224.75	126.00
	Nanduar River D/S Sitarganj Industrial Area, US Nagar	7.87	7.05	32.50	4.90	342.92	221.17
2019	Nanduar River Sitarganj Industrial Area US Nagar	7.52	6.12	26.00	5.44	203.80	121.20
	Nanduar River D/S Sitarganj Industrial Area, US Nagar	7.56	6.93	31.00	5.30	376.83	219.50
2018	Nanduar River Sitarganj Industrial Area US Nagar	7.42	3.88	15.00	6.92	374.00	242.40
	Nanduar River D/S Sitarganj Industrial Area, US Nagar	7.62	7.22	30.91	6.42	421.82	273.45
2017	Nanduar River Sitarganj Industrial Area US Nagar	7.40	3.60	27.33	7.33	479.33	318.00
	Nanduar River D/S Sitarganj Industrial Area, US Nagar	7.70	5.20	31.33	6.69	416.67	259.44

(Sources UKPCB, 2020)

River Pilakhar

Pilakhar is a spring fed river formed by confluence of various streams such as Ghoganadi, Gadarinadi and Levdanadi.Bazpur town is a major urban settlement in the upper catchment of the river. Ghoganadi receives the drainage of the town as well as industrial waste water from pulp and paper industry as well as sugar industry.

Some section of the upper catchment of Pilakhar river has been declared as polluted river stretch of priority (IV) by Central Pollution Control Board (CPCB). At present, water quality monitoring is carried out in locations falling within the jurisdiction of Uttar Pradesh government (Table 37). However; aforesaid monitoring stations will be shifted to the upstream and downstream location of Bazpur town in near future.

Table 37. Water quality characteristics of River Pilakhar (2017-2021)

Year	Monitoring location	pH	BOD (mg/l)	COD (mg/l)	DO (mg/l)	Conductivity (umhos/cm)	TDS (mg/l)
2021	Bilaspur, Ramnagar, US Nagar	7.60	5.04	19.20	7.14	783.20	512.00
2020	Bilaspur, Ramnagar, US Nagar	7.60	6.82	38.44	5.62	396.22	264.89
2019	Bilaspur, Ramnagar, US Nagar	7.52	6.85	31.67	5.38	396.75	257.33
2018	Bilaspur, Ramnagar, US Nagar	7.47	8.45	35.67	5.47	408.33	254.33
2017	Bilaspur, Ramnagar, US Nagar	7.78	4.28	26.67	6.20	622.83	405.00

(Sources UKPCB, 2020)

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River Kosi

Originating from the Bhakot Range near Kasauni, Kosi river is a major source of water needs in Almora and Nainital district. It is one of the few major Himalayan rivers which do not have a glacial source. Being a perennial river, Kosi also provides drinking water to wild animals in Jim Corbett National Park (Its catchment lies partially in Corbett Tiger Reserve). Ramnagar town is one of the major settlement area in the catchment of Kosi river.

The stretch of river Kosi from Sultanpur Patti to Pattikalam is identified as a polluter stretch of priority (IV) by Central Pollution Control Board (CPCB). This region receives wastewater from paper and pulp industries through open channels parallel to National Highway. Water Quality is being monitored in Kashipur- Bajpur road bridge (Table 38) and is found to be consistent for the past three years (BOD levels have been varying at a small rate).

Table 38. Water quality characteristics of River Kosi (2017-2021)

Year	Monitoring location	pH	BOD (mg/L)	COD (mg/L)	DO (mg/L)	Conductivity (umhos/cm)	TDS (mg/L)
2021	Bajpur Road Bridge Kashipur, US Nagar	7.66	3.38	15.80	8.08	666.80	422.80
2020	Bajpur Road Bridge, Kashipur, US Nagar	7.77	4.13	21.38	5.24	379.33	273.50
2019	Bajpur Road Bridge, Kashipur, US Nagar	7.42	4.47	19.75	5.67	373.25	255.17
2018	Bajpur Road Bridge, Kashipur, US Nagar	7.22	5.77	17.52	6.60	343.33	225.08
2017	Bajpur Road Bridge, Kashipur, US Nagar	7.36	3.56	14.76	6.73	334.00	196.30

(Sources UKPCB, 2020)

Existing situation of Polluter Stretches in Udham Singh Nagar

The prevalent water quality in the polluted river stretches are addressed based on certain indicators and their qualitative and quantitative analysis. The water quality has shown slight improvement in some stretches. All the Industries, municipal drains discharging waste water have been inventoried. Maintenance of environmental flow has become the matter of paramount importance for the concerned authorities as almost all rivers are non-perennial (Table39).

Table 39. Current Status of polluted stretches of rivers in Udham Singh Nagar

Indicator	River	Polluted Stretch	Remarks/Current Status
Water Quality (from past two years)	Bhela	Kashipur to Rajpura Tanda	High BOD level in Lohia Bridge Monitoring station,Kashipur
	Dhela	Kashipur to Garhuwala (Thakurdwara)	BOD level in the downstream monitoring station(Thakurdwara) have been significantly high.
	Kichha	Drains of Kiccha Gola river	BOD concentration has shown slight improvement from the past two years.
	Kalyani	Drains of Rudrapur	BOD levels are significant in the

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			downstream of Pantnagar industrial area. Huge Gap in BOD concentration is noticeable in upstream and downstream monitoring stations.
	Nandour/Kailash	Along Sitarganj	BOD levels in both the monitoring stations have shown much improvement from the past two years
	Pilkhar	In the vicinity of Rudrapur	BOD concentration has been consistent (Around 5-8 mg/l)
	Kosi	Sultanpur to Pattikalan	BOD concentration has been consistent (Around 3-5 mg/l)
Industrial waste water or Effluent	Bhela	Kashipur to Rajpura Tanda	GPIs are being monitored every quarter with online effluent monitoring systems provided at effluent outlet
	Dhela	Kashipur to Garhuwala (Thakurdwara)	About 29490 KLD effluent is being discharged into the river through industrial drains.
	Kichha	Drains of Kiccha Gola river	Significant volume of industrial waste water is discharged from M/S Century Pulp and Paper factory in Lalkuan including wastewater from sugar mills.
	Kalyani	Drains of Rudrapur	Kalyani river receives industrial waste water from CETP (Approx.305 industrial units connected) and ETPs from individual units (Approx. 193).
	Nandour/Kailash	Along Sitarganj	About 86 industrial units in ESIPL are connected to CETP which releases the treated waste water into the river.
	Pilkhar	In the vicinity of Rudrapur	Effluent treatment plants particularly in GPIs and some red category industries discharging waste water in the river.
	Kosi	Sultanpur to Pattikalan	An amalgamation of open channel system and underground drain networks carrying treated industrial waste water meets river Kosi near Mukanpur village.
Sewage Management	Bhela	Kashipur to Rajpura Tanda	Untreated sewage from Kashipur town is discharged into the river. No STP is available.
	Dhela	Kashipur to Garhuwala (Thakurdwara)	Sewage from individual septic tanks(in Kashipur town) is disposed in nearby drains which ultimately joins six municipal drains.
	Kichha	Drains of Kiccha Gola river	Untreated sewage from Kichha town is discharged into the river. No STP is available.
	Kalyani	Drains of Rudrapur	Untreated sewage from Rudrapur city is discharged into the river. No STP is available.
	Nandour/Kailash	Along Sitarganj	Untreated sewage from Kichha town is discharged into the river. No STP is available.

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	Pilkhar	In the vicinity of Rudrapur	Untreated sewage from Bazpur town is discharged into the river. No STP is available.
	Kosi	Sultanpur to Pattikalan	Untreated sewage from Sultanpur patti town is discharged into the river. No STP is available.
Waste Management	Bhela	Kashipur to Rajpura Tanda	Unscientific disposal of waste in the river flood plains. This may be attributed to lack of waste processing and scientific disposal.
	Dhela	Kashipur to Garhuwala (Thakurdwara)	
	Kichha	Drains of Kiccha Gola river	
	Kalyani	Drains of Rudrapur	
	Nandour/Kailash	Along Sitarganj	
	Pilkhar	In the vicinity of Rudrapur	
	Kosi	Sultanpur to Pattikalan	
Environmental flow	Bhela	Kashipur to Rajpura Tanda	As all the rivers except Kosi are non-perennial, it has become difficult to maintain natural flow during non-monsoon months. Waste water from industries is only source of flow to these rivers during lean season.
	Dhela	Kashipur to Garhuwala (Thakurdwara)	
	Kichha	Drains of Kiccha Gola river	
	Kalyani	Drains of Rudrapur	
	Nandour/Kailash	Along Sitarganj	
	Pilkhar	In the vicinity of Rudrapur	
	Kosi	Sultanpur to Pattikalan	

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NON-ATTAINMENT CITY (KASHIPUR)

Noticing unprecedented levels of air pollution in the country, the government of India launched National Clean Air Programme (NCAP) in 2019. This national level strategy aims to mitigate air pollution across the country in a time bound manner. The main target is to achieve 20% to 30% reduction in Particulate matter concentration by 2024 keeping 2017 as a base year for the comparison of concentration.

This goal is primarily set for non-attainment cities, which can be defined as the cities that have fallen short of National Ambient Air Quality Standards (NAAQS) (Table 40) for over five years. Kashipur is one of the three towns in Uttarakhand that have been declared as non-attainment city. This is due to that the fact that industries (primarily small scale and agriculture based) are rapidly increasing in Kashipur and nearby areas which has led to deteriorating air quality and overexploitation of the resources.

Table 40. 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/m3	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* 24 hours**	0.50 1.0	0.50 1.0
Carbon Monoxide (CO) mg/m^3	8 hours* 1 hour**	02 04	02 04
Ammonia (NH_3) µg/m^3	Annual* 24 hours**	100 400	100 400
Benzene (C_6H_6) µg/m^3	Annual*	5	5
Benzo (a) Pyrene (BaP)-particulate phase only, ng/m^3	Annual*	1	1
Arsenic(As), ng/m^3	Annual*	6	6
Nickel (Ni), ng/m^3	Annual*	20	20

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

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

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

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Identified sources of Air pollution in Kashipur

Industrial units which are mostly located in Kashipur-Thakurdwara road are one of the sources of air pollution in Kashipur and its nearby areas. Apart from this, vehicular pollution, agriculture residue burning, open burning of solid waste, construction activities, road dust etc. are other potential sources of air pollution in the city (Table 41).

Table 41. Air Pollution in Kashipur District

Sources of Air Pollution	Remarks	Current Status/Proposed Action
Industrial Activities	• Pulp and Paper, Distillery and Chemical Industries are prominent in the city. • More than 600 industrial units are functional in the area which includes agriculture based industries, Cottage industries etc.	• Routine monitoring and assessment of industrial emissions is done by CPCB and UKPCB. • Industries are major contributors to the high level of PM_{10} levels in the region.
Vehicular Pollution	• Three vehicle pollution emission checking centres are currently operational in Kashipur. • More than 800 diesel operated commercial vehicles are 15 years old and number is expected to increase by 1221 in coming 5 years.	• Challans are issued in violation of vehicles not having PUCs • Vehicle PUC centre are proposed to be increased by 06 which will lead to rise in vehicle surveillance by 10% every year.
Agriculture Residue/Stubble burning	• From approximately 14000 hectare of farming land for rice crop in Kashipur, nearly 13833 MT of agriculture residue is generated.	A pilot project has been proposed by agriculture department to convert residue in to fire briquettes for further use as a fuel in industries.
Other sources include burning of domestic fuel, open burning of solid waste ,construction activities and transportation of construction materials,		

Status of Annual Ambient Air Quality in Kashipur

Air quality stations have been installed in different locations of Kashipur to ascertain the air quality around the city (Table 42). Two monitoring locations have been installed lately in Anaj mandi and Ganna Ayukt area of the town. The annual air quality levels (for particulate matter) of the monitoring station located in Government hospital Kashipur have been exceeding the prescribed standards from past five years (Table 43).

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Table 42. Air Quality monitoring in Kashipur

Action Area	Outcomes
Number of manual air quality monitoring stations in the district	Three Permanent air quality monitoring stations located at the Kashipur. 1. Government Hospital (Kashipur) 2. Anaj Mandi (Kashipur) 3. Ganna Ayukt (Kashipur) *(Monitoring stations in Anaj Mandi and Ganna ayukt have been setup in 2021).*
Number of automatic air quality monitoring stations in the district	Not initiated
Ambient Air Quality Index	
Availability of air quality monitoring data	Air quality data is regularly updated in the website of Uttarakhand State Pollution Control Board (UKPCB).

Table 43. Air quality Data

Year	**Udham Singh Nagar**			
	Govt. Hospital, Kashipur			
	PM_{10}(µg/ m^3)	$SPM_{2.5}$ (µg/m^3)	SO_2 (µg/m^3)	NO_2 (µg/m^3)
2021	121.40	206.18	18.54	22.89
2020	117.30	194.31	12.07	18.06
2019	126.19	220.13	13.18	22.60
2018	105.81	211.86	--	--
2017	115.47	--	--	--
Prescribed Standards	60		20	60

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WASTE WATER MANAGEMENT AND SEWAGE TREATMENT PLANT

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

According to a report of the Central Pollution Control Board (2015), India has the capacity to treat approximately 37% of its wastewater. In other words, this comes about 22,963 million litres per day (MLD), against a daily sewage generation of approximately 61,754 MLD. Moreover, most of the sewage treatment plants do not function at their optimum capacity and do not conform to the standards as prescribed (Table 44).

Sewerage system with individual household latrines connecting with pipelines comes only 31.7% 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%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 44. 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)

Sewage treatment in U.S. Nagar District

Treatment of waste water through STP is currently not practiced in the district. Domestic households and Commercial establishment have their own Septic tank and most of them are discharged in local drains. However, an outlay has been prepared and work has been commenced on Interception and diversion works of major drains in the district. These drains will be tapped and then connected to the proposed/under construction STPs in the district (Table 45).

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Table 45. Current scenario related to STPs in the US Nagar

Number of towns with Sewage Treatment Plant in the district	**Currently, no town has operational Sewage treatment Plant in the district**
*Proposed/Under Construction STPs in the district	01 No. in Kashipur Septage (18 MLD)
	01 No. in Kashipur Bailjudi (500 KLD)
	01 No. in Kashipur Gulariya (300 KLD)
	01 No. in Dhobighat Gabiya (10 MLD)
	01 No. in Jaspur Khurd (01 MLD)
	01 No. in Hempur Ismail (02 MLD)
	01 No. in Mukundpur (500 KLD)
	01 No. in Rudrapur (FSTP) 125 KLD.
	01 No. Near Bajpur (10 MLD).
	01 No. Kiccha (3 MLD).
	01 No. Sitarganj (3 MLD).

**Apart from these, seven more STPs have been proposed under Namami Gange Mission.*

Sewage management in U.S. Nagar district

Sewerage network has been proposed for two towns of U.S. Nagar district (Kashipur and Rudrapur). Coverage is subjected to field based study (Table 46). Scientific management of waste water is desired for each ULB in near future (Table 47).

Table 46. Current standpoint regarding sewage management in the district

Parameter	**Remarks**	
Estimated Households to be connected with FSTP or STP	***ULB***	***Estimated Coverage***
	Kashipur	12 wards out of total 40 wards
	Rudrapur	Approx. 100% coverage as co-treatment is proposed as a pilot project for Rudrapur
Policy regarding decentralized wastewater management(FSSM)	As per Uttarakhand Sewage Protocol policy	
Gap in current waste water management	Provision of STP/FSTP in each ULB of district for scientific wastewater management.	

Liquid waste management in rural areas

Since the water supply for domestic purposed in rural areas has improved considerably over we4astewater 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.

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Current standpoint about Rural Waste Water Management in India

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

Table 47. Policies Undertaken for Waste Water Management in Rural India

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

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INDUSTRIAL WASTE WATER MANAGEMENT (ETP/CETP)

Effluent Treatment Plant (ETP) is a process design for treating the industrial wastewater for its reuse or safe disposal into the land. The effluent treatment plants are used for the removal of high amount of organic compounds, debris, dirt, grit, pollution, toxic, non-toxic materials and polymers, etc. from industrial effluent. The ETP plants use evaporation and drying methods, and other auxiliary techniques such as centrifuging, filtration, incineration for chemical processing and effluent treatment.

Effluent is generated in many manufacturing industries like textile, pharmaceuticals and chemicals, tanneries, etc. Contaminated water cannot be released without treatment as it contains toxic and non-toxic chemicals. Releasing it may cause contamination of the existing pure water and will affect adversely the environment. As a result, ETP's are installed in manufacturing industries.

So far, industrial policy is focused mainly on sustained growth in productivity, optimal utilisation of human capital and flexibility in adjusting to markets.

Common Effluent Treatment Plant

The concept of common effluent treatment plant has been accepted as a solution for collecting, conveying, treating and disposing of the effluents from the industrial states. The CETP concept helps small and medium scale industries to dispose of their effluents which otherwise may not be so economic to them in disposing of as a single unit. Therefore, CETP is an option which not only protects environment but also divides the investment and operational cost.

CETP can be changed to combined effluent treatment plant when it collects sewage from surrounding localities and treat it with industrial wastewaters. The advantages of such systems are:

- Dilution of toxic constituents and dissolved inorganic solids from the industrial wastewaters.
- Better control over the process due to continuous seeding of microorganisms from sewage.
- Sewage provides sufficient nutrients (N, P).
- Reduced operating cost in the form of adding chemicals.

CETPs in Uttarakhand

Currently, three CETPs are operational in the state, primarily in SIDCUL which connects more than 900 different industrial units in different cities in Uttarakhand (Table 48).

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Table 48. State Scenario of CETPs

Total CETPs in Uttarakhand	**(3)** • IIE SIDCUL, Pantnagar • CETP Sitarganj • SIDCUL Haridwar
Total Design Capacity (MLD)	13
Members Units (Industrial Units)	920

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

Industrial Waste water in Udham Singh Nagar

Two CETPs are currently operational in Udham Singh Nagar district in IIE SIDCUL, Pantnagar and Sitarganj. About 400 industries are connected with the CETPs (Table 49). All the industries are meeting standards for effluent discharged in the rivers (Table 50). Effluent discharged standards are being adhered as per the data for the months of October'21 and December'21(Table 51).

Table 49. Inventory of Industries and waste water generation in US Nagar district

S. No.	Parameter		Present Status		
1.	Prominent Industries in US Nagar		1. Pulp & paper 2. Sugar & Distilleries 3. Chemical units 4. Automobile Assembling 5. Pharmaceuticals 6. Food processing unit		
2.	Number of industries discharging waste water		257		
3.	Total quantity of industrial wastewater generated (MLD)		40		
4.	Quantity of treated waste water discharged into water bodies (MLD)		30		
5.	Quantity of un-treated or partially treated Industrial waste water discharge into lakes		NIL (Many industries operate on zero liquid discharge)		
6.	Number of Common Effluent Treatment Plant facilities (CETP)		02		
7.	Common Effluent Treatment Plant facilities	Name of CETP	Member units connected (members)	Type of Industries	Designed capacity (MLD)
		IIE SIDCUL, CETP, Pant Nagar	309	Mixed	4.0
		CETP, Sitarganj	97	Mixed	3.8

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Table 50. Status of compliance by Industries

S. No.	Action Areas	Outcomes
2.	Number of industries not meeting standards	NIL
3.	Number of complaints received against industrial pollution in last 3 months	No complaints received in last three months regarding breeching of industrial norms.

Current Status Regarding Effluent Treatment Plant in US Nagar District

- Major Industrial cluster is Integrated Industrial Estate (IEE), SIDCUL (State Industrial Development Corporation of Uttarakhand limited), US Nagar which is well connected with Common Effluent Treatment System (CETP) and equipped with online continuous effluent monitoring system (OCEMS).
- Uttarakhand State Pollution Control Board is doing regular Monitoring /Sampling.
- Pollution load in surface water streams/rivers/drains especially in Nakti Nala, has been a matter of concern.
- Grossly Polluting Units (GPI's) have their own treatment facility (In-house effluent treatment plant) and are also connected with OCEMS (online continuous effluent monitoring system)

Table 51. Monthly Report of CETP Outlet at SIDCUL Rudrapur and Sitarganj

Sampling location	Month	pH	BOD (mg/l)	COD (mg/l)	TSS (mg/l)
Common Effluent Treatment (CETP) outlet, SIDCUL, Rudrapur	Oct-21	7.45	21.8	145	23
	Dec-21	6.93	28	180	66
Common Effluent Treatment (CETP) outlet, SIDCUL, Sitarganj	Oct-21	7.56	24	158	26
	Dec-21	6.96	26	220	78
Prescribed standards		*6.5-8.5*	*30*	*250*	*100*

Table 52. Proposed policies and desired level of compliance as per different stakeholders

Strategy/Policy	Purpose
Proposed CETP for Pant Nagar Industrial area	To cater the growing need of safe effluent disposal from the industrial estate.
Implementation of maximisation water recycling extent in the grossly effluent generating units such as paper mills, sugar mills and distillery.	To achieve Zero liquid discharge and minimization of pollution load into surface water streams/rivers/drains.
Enforcement in major polluting units to upgrade augmentation/modification in manufacturing process and effluent treatment plants.	• To minimize the water consumption extent • To improve the quality of treated water for maximum recycling in the process.

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INDUSTRIAL CLUSTERS

A cluster is a geographically proximate group of interconnected companies and associated institutions in a particular field, that share common markets, technologies, worker's skill needs and which are often linked by buyer-seller relationships. Industries are growing at common centres/estates/parks as the resources, man power, transportation, marketing are feasible. Generally, medium and small-scale industries are developed at such areas and form Industrial clusters. Industrial clusters are increasingly recognized as an effective means of industrial development and promotion of small and medium-sized enterprises. Due to lack of awareness and ignorance of waste management technologies, environmental pollution has been proliferated to surrounding environment. Therefore, such industrial areas have to be assessed for improving the quality of the environment.

The Ministry of Environment, Forest and Climate Change (MoEFCC) has developed the criteria for categorization of industrial sectors based on the Pollution Index, which is a function of the emissions (air pollutants), effluents (water pollutants), hazardous waste generated and consumption of resources (Table 53).

Moreover, Central pollution control board (CPCB) developed Comprehensive Environment Pollution index (CEPI) to find out the index value to characterise quality of the environment. Monitoring is carried out by CPCB through recognized environmental laboratory periodically and CEPI is assessed based on the recorded monitoring data (Table 54). The evaluated CEPI reflects the environmental quality of the industrial areas and serve as a standard to assess the progress achieved in the implementation of action plans. Table 55describes number of industries in Haridwar district based on pollution index.

Table 53. Based on pollution Index (Categorization of Industries Based on Range Indices)

Pollution Index of industrial Sectors	Category
60 and above	Red
Between 41 and 59	Orange
Between 21 and 40	Green
Up to 20	*White

**A new category of white industries, which is practically non-polluting, does not require Environmental Clearance (EC) and Consent and will help in getting finance from lending institutions*.

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Table 54. Based on CEPI Score

CEPI Score	Category
Exceeding 70	Industrial cluster is treated as critically polluted
Between 60-70	Industrial cluster is treated as severally polluted

Table 55. Inventory of industries in Rudrapur, Udham Singh Nagar

Industrial-scale/category	Red	Orange	Green	Total
Small Scale	25	65	97	187
Medium Scale	10	29	24	63
Large Scale	33	64	40	137
Total Industries	**68**	**158**	**161**	**387**

Table 56. Existing Status of Industrial Areas in the District U.S Nagar

Name of Industrial area	Land developed (in hectare)	No. of Units in Production
IIE SIDCUL Pant Nagar	3339	465
SIDCUL Sitarganj	1099.43	284
Bio-Tech Park Pantnagar	100.00	12

Air and Water Quality Monitoring in Industrial Areas of US Nagar

Air and Water quality parameters are monitored to check the pollution levels in the Industrial areas of the US Nagar. Yearly data for air pollution is recorded for the past 5 years (Table59) and half-yearly data of groundwater quality is recorded for the year 2020 and 2021. PM_{10}value depicts air quality as satisfactory to moderately poor. Groundwater parameters are within permissible limits (Table 60& 61).

Table 57. Air quality monitoring in the Industrial area of US Nagar

Year	Industrial area of Udham Singh Nagar					
	Industrial area, Kashipur			Industrial area, Rudrapur		
	PM_{10} ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
2021	118.13	18.54	22.89	126.50	19.43	22.94
2020	116.94	12.07	18.06	114.42	11.84	17.86
2019	126.19	13.18	22.60	129.13	13.61	22.66
2018	105.81	--	--	119.08	--	--
2017	116.49	--	--	133.15	--	--
Standards (Annual)	***60***	***50***	***40***	***60***	***50***	***40***

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Table 58. Ground water quality monitoring is performed at selected areas of US Nagar (Data April 2021)

Parameter	Near Govt. Primary, Kashipur	Near Chatti Chaurah, Bazpur road Kashipur	Glycol India Ltd. Kashipur	Near KVS Bazpur Road Kashipur	Gurudwara Muradabad Road, Kashipur	Sitarganj Industrial area-1 Kashipur	Sitarganj Industrial area-2 Kashipur	Pantnagar Industrial area-1	Pantnagar Industrial area-2 Kashipur	Santipuri, Kichha -1	Santipuri, Kichha -1	**Acceptable Limits (As per IS:10500-2012**	**Permissible Limits (As per IS:10500-2012**
pH	7.4	Dry	8.0	7.7	7.5	7.2	7.1	7.7	7.6	7.5	7.3	**6.5-8.5**	**No Relaxation**
Total dissolved Solids (mg/l)	215	Dry	128	188	220		208	169	191	137	184	**500**	**2000**
Chloride (mg/l)	13	Dry	19	14	30	30	28	20	19	15	23	**250**	**1000**
Magnesium Mg (mg/l)	40	Dry	60	45	203	82	80	63	64	64	74	**30**	**100**
Calcium Ca (mg/l)	148	Dry	91	65	42	124	135	111	92	131	99	**1**	**1.5**
Conductivity (uS/cm)	354	Dry	228	294	400	547	529	278	293	326	276	**NA**	**NA**
Total Hardness (mg/l)	198	Dry	177	135	-	185	189	194	160	185	197	**200**	**600**
Alkalinity as CaCo3 (mg/l)	-	Dry	156	158	131	208	212	144	168	183	214	200	**500**

Table 59. Ground water quality monitoring is performed at selected areas of US Nagar (April 2020)

Parameter	Near Govt. Primary, Kashipur	Near Chatti Chaurah, Bazpur road Kashipur	Glycol India Ltd. Kashipur	Near KVS Bazpur Road Kashipur	Gurudwara Muradabad Road, Kashipur	Sitarganj Industrial area-1 Kashipur	Sitarganj Industrial area-2 Kashipur	Pantnagar Industrial area-1	Pantnagar Industrial area-2 Kashipur	Santipuri, Kichha -1	Santipuri, Kichha -1	**Acceptable Limits (As per IS:10500-2012**	**Permissible Limits (As per IS:10500-2012**
pH	7.6	Dry	8.0	7.8	7.8	Dry	7.4	7.5	NA	7.9	7.8	**6.5-8.5**	**No Relaxation**
Total dissolved Solids (mg/l)	215	Dry	190		275	Dry	368	226	NA	230	204	**500**	**2000**
Chloride (mg/l)	14	Dry	18	12	28	Dry	26	16	NA	16	24	**250**	**1000**
Magnesium Mg (mg/l)	38	Dry	63	48	216	Dry	79	54	NA	60	77	**30**	**100**
Calcium Ca (mg/l)	155	Dry	94	67	44	Dry	139	96	NA	118	100	**1**	**1.5**
Conductivity (uS/cm)	374	Dry	258	304	410	Dry	549	303	NA	312	296	**NA**	**NA**
Hardness (mg/l)	193	Dry	157	115	260	Dry	216	150	NA	178	177	**200**	**600**
Alkalinity as CaCo3 (mg/l)	148	Dry	176	160	128	Dry	219	156	NA	172	200	**200**	**500**

Integrated Industrial Area Pantnagar, Rudrapur, Udham Singh Nagar

IIA Pantnagar, Rudrapur is the largest Integrated Industrial Estates owned by SIDCUL, Government of Uttarakhand. It is one of the major Automobile hubs of the country having brand

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presence of Bajaj Auto Limited, Ashok Leyland etc. Table 60 represents different scale of industries in IIA Rudrapur which are further classified into categories based on pollution load.

Table 60. Classification of different scale of Industries in IIA Rudrapur

Industrial Scale/Category	Green	Orange	Red
Small Scale	97	65	25
Medium Scale	24	29	10
Large Scale	40	64	33
Total Industries	**161**	**158**	**68**

Sources of Pollution in IIA Pantnagar, Rudrapur

Industrial units mainly Ply wood manufacturing units and corn processing units have been identified as the major source of pollution in the industrial area. Moreover, domestic sewage is also one of major component of surface water pollution. Based on the CEPI score monitoring conducted by Uttarakhand State Pollution Control Board in the month of December 2019, it was observed that the CEPI score of IIA Rudrapur was 77.7 (Table 61).

Table 61. Details of CEPI score of Polluted Industrial Area, IIA Rudrapur

Name of Industrial Area	Environmental parameters	Criterial Pollutants	EPI score	CEPI score
IIA Rudrapur	Air	PM_{10}, $PM_{2.5}$,CO	29.50	77.7
	Water	Phenol,T,Phos,TKN	76.25	
	Land	T. Hard, Fe,Mn	21.00	

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GROUND WATER EXTRACTION/CONTAMINATION AND RE-CHARGE

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

Groundwater extraction

Over 80-85% of our country's 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 the untreated waste from septic tanks and toxic chemicals from underground storage tanks and leaky landfills.

Groundwater Recharge

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

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Table 62. Water Resources in the District

S. No.	Water Resource	Number			Name and Length/Area in the District	
		Perennial	***Non-perennial***	***Total***	***Name***	***Length (km) (Approx.)***
	Rivers	02	12	14	Feeka	20
					Dhella	23
					Kosi	12
					Lewda	16
					Nihal	22.5
					Bhakda	24.5
					Khajiya	23.5
					Gola	22.5
					Parveen	49
					Kaman	13.7
					Nihaee	8.7
					Deviha	40
					Kailash	32
					Shukhi	21

Table 63. Pollution control in Water Resources

S. No.	Parameter	Current Status
1.	Open Defecation in River/Nala/Khad	Partially controlled
2.	Dumping of Solid waste on River Banks	Partially controlled
3.	Control Measures for idol immersion	No measures taken
4.	Number of Nalas/Drains meeting Rivers	38 Drains (drains meeting 07 polluter river stretches
5.	Number of directions given to Industries for discharge of untreated industrial wastewater in past on year	12 (Directions issued under relevant section of the Water act, 1974)
6.	Estimated number of bore-wells/hand pumps	420 government tube wells(all are operational)
7.	Groundwater polluted area in the district	None
8.	Monitoring of Action Plans for rejuvenation of rivers	Monitored
9.	Adequacy of groundwater availability	Adequate

Table 64. Groundwater availability in the district

Assessment unit name	Total Annual groundwater Recharge (ham)	Stage of Groundwater Extraction (%age)	Categorization
Jaspur	7039.76	80.54	Semi–Critical
Kashipur	8755.30	87.09	Semi–Critical
Bazpur	13164.14	79.70	Safe

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Table 65. Half-yearly groundwater monitoring (*at 11 monitoring stations)* (April 2021)

Parameter	Near Govt. Primary, Kashipur	Near Chatti Chaurah, Bazpur road Kashipur	Glycol India Ltd. Kashipur	Near KVS Bazpur Road Kashipur	Gurudwara Muradabad Road, Kashipur	Sitarganj Industrial area-1 Kashipur	Sitarganj Industrial area-2 Kashipur	Pantnagar Industrial area-1	Pantnagar Industrial area-2 Kashipur	Santipuri, Kichha -1	Santipuri, Kichha -1	**Acceptable Limits (As per IS:10500-2012**	**Permissible Limits (As per IS:10500-2012**
pH	7.4	Dry	8.0	7.7	7.5	7.2	7.1	7.7	7.6	7.5	7.3	**6.5-8.5**	**No Relaxation**
Total dissolved Solids (mg/l)	215	Dry	128	188	220		208	169	191	137	184	**500**	**2000**
Chloride (mg/l)	13	Dry	19	14	30	30	28	20	19	15	23	**250**	**1000**
Magnesium Mg (mg/l)	40	Dry	60	45	203	82	80	63	64	64	74	**30**	**100**
Calcium Ca (mg/l)	148	Dry	91	65	42	124	135	111	92	131	99	**1**	**1.5**
Conductivity (uS/cm)	354	Dry	228	294	400	547	529	278	293	326	276	**NA**	**NA**
Total Hardness (mg/l)	198	Dry	177	135	-	185	189	194	160	185	197	**200**	**600**
Alkalinity as CaCo3 (mg/l)	-	Dry	156	158	131	208	212	144	168	183	214	**200**	**500**

Table 66. Half yearly ground water monitoring (*at 11 monitoring stations)* (April 2020)

Parameter	Near Govt. Primary, Kashipur	Near Chatti Chaurah, Bazpur road Kashipur	Glycol India Ltd. Kashipur	Near KVS Bazpur Road Kashipur	Gurudwara Muradabad Road, Kashipur	Sitarganj Industrial area-1 Kashipur	Sitarganj Industrial area-2 Kashipur	Pantnagar Industrial area-1	Pantnagar Industrial area-2 Kashipur	Santipuri, Kichha -1	Santipuri, Kichha -1	**Acceptable Limits (As per IS:10500-2012**	**Permissible Limits (As per IS:10500-2012**
pH	7.6	Dry	8.0	7.8	7.8	Dry	7.4	7.5	NA	7.9	7.8	**6.5-8.5**	**No Relaxation**
Total dissolved Solids (mg/l)	215	Dry	190		275	Dry	368	226	NA	230	204	**500**	**2000**
Chloride (mg/l)	14	Dry	18	12	28	Dry	26	16	NA	16	24	**250**	**1000**
Magnesium Mg (mg/l)	38	Dry	63	48	216	Dry	79	54	NA	60	77	**30**	**100**
Calcium Ca (mg/l)	155	Dry	94	67	44	Dry	139	96	NA	118	100	**1**	**1.5**
Conductivity (uS/cm)	374	Dry	258	304	410	Dry	549	303	NA	312	296	**NA**	**NA**
Hardness (mg/l)	193	Dry	157	115	260	Dry	216	150	NA	178	177	**200**	**600**
Alkalinity as CaCo3 (mg/l)	148	Dry	176	160	128	Dry	219	156	NA	172	200	**200**	**500**

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Current standpoint regarding Water Resources Management and Groundwater Quality in US Nagar district

Present state of affairs

- Ground water quality monitoring under National Water Resources Monitoring Programme (NWMP) is being carried by Uttarkhand Pollution Control Board (UKPCB) at 11 locations
- Random Checking of groundwater quality at probable contaminated locations is also done by UKPCB. Moreover, monitoring at two new locations at upstream and downstream of Polluted River Stretches are also carried out at half yearly basis.
- Central groundwater Water Board (CGWB) exercises assessment and computation of groundwater resources once in every three years in consultation with State government departments. Beside this, CGWB conducts awareness programs in several areas to solve local groundwater problems and discuss methods of groundwater conservation through participatory approach.
- Rain water harvesting techniques are encouraged in various industries of the district.

Artificial Recharge Potential of US Nagar District

Uttarakhand state has a very prominent drainage system varying from first to fifth order with main drainage patterns being dendritic, trellis and rectangular. Major part of the hilly areas 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). Ground water mainly occurs under unconfined conditions and the water table follows the topography. The entire area falling in the foot hills of the Himalayas i.e. Bhabar areas and the intermountain Doon gravel areas have been considered as areas suitable for ground water augmentation through artificial recharge. Udham Singh Nagar (US Nagar) has, by and large, plain topography with very shallow water levels, hence roof top rainwater harvesting is the only feasible option available in this area.

Table 67. Artificial recharge of groundwater in US Nagar

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)
US Nagar	3055	764	1528	229	305.00	1911

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Table 68. Artificial recharge structures constructed in US Nagar under CACMP (Catchment area conservation programme)

District	Number of Structures					Total Cost (in lakhs)					Total Cost (In lakhs)
	CD	*CK*	*RTRWH*	*PT*	*CT*	*CD*	*CK*	*RTRWH*	*PT*	*CT*	
US Nagar	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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

Table 69. Proposed artificial recharge structures with cost estimate

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	
US Nagar	700	50	0	0	0	0.5	0.3	0.07	0.15	0.015	350	15	0	0	0	365

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

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AIR AND NOISE POLLUTION MANAGEMENT

Air Pollution Management

The ambient air that is the atmospheric air in its natural form consists of nearly 99.9% of Nitrogen, Oxygen, Water vapors, Carbon dioxide, and some other gases like helium, argon, methane, argon, etc. surrounds the earth and forms its atmosphere. Any undesirable change in the composition of ambient air is called air pollution. The undesirable substances can be in solid, liquid, and gaseous forms and when present in sufficient concentration for a sufficient time under certain conditions can endanger human health and welfare of plants and animals. According to state of Global Air report 2020, Air pollution has now become the biggest health risk in India. Most of the cities in our country (majority of them are from the region of Indo-Gangetic plains) are facing the problem of air pollution which has led to increase in cases of breathing discomfort and other related diseases. To tackle the problem of air pollution in our cities, Government of India has taken many steps, one of them being National Clean Air Programme (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 $PM_{2.5}$ and PM_{10} concentration by 2024 is proposed under the NCAP taking 2017 as the base year for the comparison of concentration. The ambient air quality standards as set by Central Pollution Control Board are mentioned in Table 70.

Table 70. 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* 24 hours**	0.50 1.0	0.50 1.0
Carbon Monoxide (CO) mg/m^3	8 hours*	02	02

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	1 hour**	04	04
Ammonia (NH_3) µg/m^3	Annual* 24 hours**	100 400	100 400
Benzene (C_6H_6) µg/m^3	Annual*	5	5
Benzo (a) Pyrene (BaP)-particulate phase only, ng/m^3	Annual*	1	1
Arsenic(As), ng/m^3	Annual*	6	6
Nickel (Ni), ng/m^3	Annual*	20	20

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

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

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

Current scenario of air pollution in Udham Singh Nagar

Permanent air quality stations at different locations (some of them in sensitive zone) have been installed in Kashipur and Rudrapur cities of the district. Infact, these cities are the major industrial hubs of Uttarakhand (Table 71). Apart from industries, vehicular pollution, stubble burning, road dust etc. are the other major causes of air pollution in the district (Table72).

Action plan has been formulated for the only non-attainment city i.e. Kashipur by State Pollution Control Board. (Table73). The main focus of the state pollution control board has been to monitor the air quality levels in the industrial areas of the district primarily in Kashipur and Rudrapur.

Table 71. Air quality monitoring and data accessibility

Action Area	Outcomes
Number of operational manual air quality monitoring stations in the district	Four (Permanent air quality monitoring stations) are operational in the district at following locations: 1. Government Hospital, Kashipur 2. Anaj Mandi, Kashipur 3. Ganna Ayukt, Kashipur 4. Government Hospital,Rudrapur
Number of automatic air quality monitoring stations in the district	Zero (Presently not installed)
Ambient Air Quality Index	Moderate
Availability of air quality monitoring data	Air quality data is regularly updated in the website of Uttarakhand State Pollution Control Board (UKPCB)

Table 72. Identification of sources of air pollution

Action area	Outcomes
Number of non-attainment cities in the district	(One) Kashipur city in the district is classified as non-attainment city according to National Clean Air Programme(NCAP).

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Prominent sources of air pollution in the district	• Industries • Vehicular Pollution • Stubble burning
Industrial Pollution	Large Industries such as: Sugar Industries Distilleries Pulp and Paper Industries are majorly responsible for air pollution in the district.
Non-Industrial air pollution	
Vehicular pollution	Following areas have been identified as hotspots for Vehicular pollution: • Kashipur • Pantnagar • Rudrapur • Sitarganj
Stubble burning	Prominent in Winter seasons
Control of open burning of waste	Open burning of waste is prohibited, even then practices of burning of waste is common in the district.
Other sources of Air pollution	Road dust , Fuel wood and coal for cooking (Specially in road side dhabas /Local Restaurants)

Table 73. Control measures for industrial/non industrial air pollution

Action Areas	Outcomes
Control of industrial air pollution	As much as 1367 Industrial units are meeting the prescribed air quality standards.
District level action plan for air pollution	Air action plan for Kashipur Non-attainment city has been prepared by UKPCB in 2019.
Awareness on air Quality	People are not yet apprised of the health risks associated with the air pollution when levels are high.
Development of Air pollution complaint redressed system	Available online at the official website of Uttarakhand Pollution Control Board (UKPCB)

Air Quality monitoring and proposed policies forUdham Singh Nagar

Air quality data is available for the past five years for two monitoring stations in Kashipur and Rudrapur (Table 74). PM_{10}values have exceeded the prescribed standards every year. Recently two more monitoring stations have been installed in Kashipur monthly air quality data (Table 75) and one more has been proposed in Rudrapur town by Uttarakhand Pollution Control Board(UKPCB).

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Table 74. Air quality monitoring in Udham Singh Nagar (2018-2021

Year	Udham Singh Nagar							
	Govt. Hospital, Kashipur				Govt. Hospital, Rudrapur			
	PM_{10} (µg/ m^3)	SPM (µg/ m^3)	SO_2 (µg/ m^3)	NO_2 (µg/ m^3)	PM_{10} (µg/ m^3)	SPM (µg/ m^3)	SO_2 (µg/ m^3)	NO_2 (µg/ m^3
2021	121.40	206.18	18.54	22.89	126.50	216.40	19.43	22.94
2020	116.94	194.31	12.07	18.06	114.42	194.64	11.84	17.86
2019	126.19	220.13	13.18	22.60	129.13	227.67	13.61	22.66
2018	105.81	211.86	--	--	119.08	224.64	--	--

Table 75. Monthly Air quality data for the year 2022

City	Kashipur						Rudrapur	
Location	**Govt. Hospital**		**Anaj Mandi**		**Ganna Ayukt**		**Govt. Hospital**	
Zone	Sensitive						Sensitive	
Month	PM_{10} (µg/m^3)	$PM_{2.5}$ (µg/m^3)	PM_{10} (µg/m^3)	$PM_{2.5}$ (µg/m^3)	PM_{10} (µg/m^3)	$PM_{2.5}$ (µg/m^3)	PM_{10} (µg/m^3)	$PM_{2.5}$ (µg/m^3)
January	128.55	55.98	152.44	73.37	145.28	64.12	127.63	-
February	121.98	62.05	135.15	64.39	142.99	70.69	128.59	-
Average	**125.27**	**59.02**	**143.50**	**68.88**	**144.14**	**67.41**	**128.11**	-

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Noise Pollution Management

Noise pollution may be defined as regular exposure to elevated sound levels that may lead to adverse effects in humans or other living organisms. According to WHO sound levels less than 70 dB are not damaging to living organisms and exposure of noise level beyond 85 dB constantly for more than 8 hrs. may be hazardous and leads to loss of hearing. Although noise pollution is not a big issue in the district but proper monitoring is required to maintain noise level within the desirable limits (Table76).

Table 76. Permissible noise level standards

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

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

- Day time shall mean from 6.00 a.m. to 10.00 p.m.
- Night time shall mean from 10.00 p.m. to 6.00 a.m.
- 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
- 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.
- "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 in U.S. Nagar District

Routine monitoring is carried out at 6 different locations in Kashipur and Rudrapur city. Some complaints related to noise pollution have been registered by the pollution control board in past one year. (Table 77).

Table 77. Current status related to noise pollution management in US Nagar

S. No.	Parameter	Current Status
1.	Number of noise level measuring devices available with various agencies in the district.	02
2.	Number of complaints received by State pollution control board related to noise pollution in past 1 year.	08 Complaints were registered. All of them were redressed.
3.	Implementation of ambient noise standards in residential and silent zones.	Occasionally
4.	Capability to conduct noise level monitoring by State agency/District Authorities	Available with the competent authority
5.	Noise monitoring study in district	Monitoring is carried out in different zones and locations of Kashipur and Rudrapur.
6.	Setting up of Sign Boards	Not installed

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7.	Routine monitoring of Ambient Noise level at various locations	Initiated
8.	Responsibility of departments regarding vehicular noise pollution	• Vehicular noise pollution coming under Motor Vehicles Act,1998 • State Transport department is responsible for execution of noise standards and implementation of noise control measures.

Monitoring of Noise Levels in US Nagar district

Noise levels are measured in Rudrapur and Kashipur city of the district at different zones (Table 78). Noise data for the month of January shows breach of prescribed standards in each zone at different locations. Noise level monitoring is also done in festive times, especially pre Deepawali and Deepawali day to understand the impact of noise pollution due to burning of fire crackers. Data shows elevated sound levels on the day of Deepawali when compared to a day before (Table 79).

Table 78. Noise levels as of January,2022

Monitoring locations	Zone	Average $L_{equivalent}$ dB(A) 2022
Govt. Hospital, Kashipur	Silence	39.79
M.P.Chowk Kashipur	Commercial	79.83
Residential Area Awas Vikas, Kashipur	Residential	47.08
Govt. hospital, Rudrapur	Silence	48.91
DD Chowk ,Rudrapur	Commercial	78.41
Residential area Awas Vikas, Rudrapur	Residential	57.83

Table 79. Noise level monitoring carried out during Deepawali Festival (2019 and 2021)

Monitoring locations		Average $L_{equivalent}$ dB(A)			
	Zone	Pre Deepawali Day (21.10.2019)	Deepawali Day (27.10.2019)	Pre Deepawali Day (29.10.2021)	Deepawali Day (04.11.2021)
Govt. Hospital, Kashipur	Silence	49.38	63.37	48.1	62.49
M.P.Chowk Kashipur	Commercial	68.43	81.56	70.45	78.8
Awas Vikas, Kashipur	Residential	68.67	89.90	66.77	73.99
Govt. hospital, Rudrapur	Silence	56.24	70.92	48.42	61.87
DD Chowk Rudrapur	Commercial	65.89	84.66	70.57	78.49
Awas Vikas, Rudrapur	Residential	65.50	78.42	65.1	75.3

Table 80. Responsibility of various departments to mitigate noise pollution

Responsibility	Department Responsible
Ban on use of Multi-toned horn or any other device giving an unduly harsh, shrill, loud, or alarming noise (Nothing contained in this policy shall prevent the use on vehicles used as an ambulance, vehicles used by police officers, Fire fighters, Operators of construction equipment vehicles or the officers of motor vehicle departments).	State Transport department
Execution of noise standards and implementation of Noise control measures.	State Transport department

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ILLEGAL SAND MINING

The Mines and Minerals (Development and Regulation) Act, 1957 has empowered state governments to make rules to prevent illegal mining, transportation and storage of minerals. However, still large numbers of illegal mining cases are registered in the country and in some cases, many of the officers even lost their lives while executing their duties to curb illegal mining. Ministry of Environment, Forest & Climate Change (MoEF&CC) 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, new set of guidelines have been put forward by (MoEF&CC) in 2020, which focuses on the effective monitoring of sand mining (from the identification of sand mineral sources to its dispatch and end-use by consumers and general public) and uniform protocol for the whole country. Also, states are advised to conduct river audits and monitoring of mining activities with night vision drones and other modern surveillance equipment.

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.

Mining activities in the district.

Sand mining is prevalent in the district. Illegal mining activities haven't been noticed yet in the district as per state pollution control board record (Table 81). Cases of illegal sand mining have been registered in the district. Subsequently, Penalties were imposed by mining department. (Table 82) However, no pollution related complaints have been registered for past one year (Table 83).

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Table 81. Current status of mining activities in US Nagar

Concerning Department	Total number of mining sites	Operational mining sites	Area under mining activities (ha)	Type of mining activity (Legal/ Illegal)	Revenue generated (financial year (2020-2021)
Mining Department	22	22	47.626	Legal	43,68,63,182.00
Forest Department	01	01	90.00	Legal	1,63,15,000

(Source: Mining Department US Nagar, 2021)

Table 82. Prevalent Mining Activities in US Nagar

Total area of District (km^2)	2542
Type of Mining Activity	River bed mining mainly sand is prevalent in the US Nagar.
Total no of sand mining sites in the district	There are total 22 sand mining sites are there in the US Nagarall sites are operational in the district.
Action against illegal mining activities in the district (in the financial year 2020-21)	34 cases registered for illegal mining activities
Penalties charged for the illegal mining activities	Rs. 2,02,04,917 have been imposed for illegal mining activities in the US Nagar.

Table 83. Compliance with environmental standards

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

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REJUVENATION OF WATER BODIES

Most of India's major water resources (underground waterways, lakes, rivers and reservoirs) depends on monsoon rains to replenish/recover them. Nearly 600 million Indians faced high to extreme water stress and about 2 lakh people dies 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.High amount of water extraction and mismanagement of water resources are causing drought and sudden flood in several part of our country. Rejuvenation of waterbodies also play a vital role to improve the water quality and storage of surface run off water. For these reasons we need to store, manage and rejuvenate the existing waterbodies. We can use several government policies/Schemes like Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), 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).

Rejuvenation works in U.S. Nagar district

Small ponds have been constructed by district administration in U.S. Nagar to cater for the growing water demand (Table 84). Some of them are encroached by the local people upon which the officials have to take strict action. More than 250 Ponds have been constructed under MNREGA and around 30 are under progress (Table 85)

Table 84. Water bodies rejuvenated by US Nagar

Water Resource	Block Name	Existing ponds	Ponds currently in their serviceable situation
Lake/Pond	Jaspur	165	42
	Kashipur	151	82
	Bajpur	51	11
	Gadarpur	81	56
	Rudrapur	98	20
	Kichha	172	81
	Sitarganj	287	168
	Khatima	229	76
	Rudrapur	20	02
	Kashipur	20	07
	Total	**1274**	**545**

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Table 85. Inventory of water bodies in US Nagar

Water Resource	Block Name	Ponds constructed	Ponds under construction
Lake/Pond	Jaspur	14	02
	Kashipur	01	--
	Bajpur	20	--
	Gadarpur	15	02
	Rudrapur	28	--
	Kichha	07	15
	Sitarganj	67	11
	Khatima	108	--
	NN Rudrapur	00	--
	NN Kashipur	00	--
	Total	**260**	**30**

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PLASTIC WASTE MANAGEMENT

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

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

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

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

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

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

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

Current scenario of Plastic waste in US Nagar district

Plastic waste exists as mixed waste (part of dry waste) in U.S. Nagar district. Quantities are estimated at Transfer station/dumping site where secondary segregation is performed. Plastic waste after compaction is sold to local rag pickers.

Table 86. Inventory of Plastic Waste Generation

Name of Urban Local Body	Population (2011 census)	Number of Wards	Estimated Quantity of Plastic Waste Generated (MT/Day)
NN Kashipur	175819	40	2.98
NN Rudrapur	175723	40	2.00
NPP Gadarpur	23289	11	0.04
NPP Bajpur	31172	13	0.05
NPP Jaspur	50523	09	Not estimated
NPP Kichha	74356	20	0.02
NPP Sitarganj	31711	13	0.02
NPP Khatima	58494	20	Not estimated
NPP Mahuwa Khedaganj	12584	09	0.42
NP Mahuwadabra	7326	07	0.03
NP Sultanpur	9881	07	0.24
NP Khelakheda	10929	09	0.01
NP Dineshpur	11783	09	Not estimated
NP Shaktigarh	6314	07	0.02
NP Nanakmatta	8478	07	Not estimated
NP Gularbhoj	6957	07	0.08

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Table 87. Present Infrastructure for Plastic Waste Management Operations

Name of ULB	Inventory of infrastructure available for plastic waste management operation		
	Availability of plastic compactor	**Linkage with Plastic waste recyclers**	**Remarks**
NN Kashipur	Available	Except Nagar Khelakheda no other ULB has established linkage with any plastic waste recycler.	Plastic waste is compacted in dump site or transfer station. It is then sold to local rag pickers
NN Rudrapur	Available		
NPP Gadarpur	Available		
NPP Bajpur	Available		
NPP Jaspur	Available		
NPP Kichha	Available		
NPP Sitarganj	Available (Not operational)		
NPP Khatima	Not Available		
NPP Mahuwa Khedaganj	Available		
NP Mahuwadabra	Not Available		
NP Sultanpur patti	Available		
NP Khelakheda	Not Available		
NP Dineshpur	Not Available		
NP Shaktigarh	Available		
NP Nanakmatta	Available		
NP Gularbhoj	Available		

Identification of Gap

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

Projected Population and Plastic Waste Generation in US Nagar District

Plastic waste in India has increased steadily over the past 50 years. It is expected to double over the next 20 years. Its growth rate in India is considered to be the highest in the world.

Projecting waste quantities in coming future is a difficult task. It is because of its changing composition over the seasons and periods due to ever changing dietary habits, economic conditions of the people and pandemic situation like COVID-19 in the concerned region. Crop harvesting season with adequate availability of a variety of food also affect the plastic generation. Lower is the level of economic development, greater will be the change between plastic waste

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generation and disposal. Moreover, COVID-19 like pandemic situation also caused remarkably plastic waste generation for creating medical tools and devices. These could be syringes, insulin pens, intravenous line (IV), surgical gloves, catheters, inflatable splits, etc. generation for creating medical tools and devices. These could be syringes, insulin pens, intravenous line (IV), surgical gloves, catheters, inflatable splits etc.

Census population data for the years 2001 and 2011 has been taken for population forecast (Table 89). Decadal population and subsequent waste forecast has been done based on the following presumptions:

- Arithmetic increase method is used for the decadal population forecast, hence the rate of change of population with time is assumed constant.
- The per capita generation of plastic waste was estimated to be 11 kg/annum (Centre for Science and Environment, 2019).
- It is assumed that 70% of the total plastic waste consumed is discarded as waste (CPCB, 2013).
- 16 % yearly growth in per capita plastic waste consumption has been taken keeping in mind the changing waste paradigm and floating population. *(Centre for Science and Environment,2019)*
- This analysis included population and waste generation estimations for only urban local bodies and did not include peri-urban and rural areas (Table 88; Fig.06).

Table 88. Projected population and estimated plastic waste generation in U.S. Nagar district

ULB	**Projected Population**			**Existing/Projected Plastic Waste Generation (MTPD)**		
	2021	**2031**	**2041**	**2021**	**2031**	**2041**
Nagar Nigam Kashipur	150279	178935	207591	2.98	9.23	27.83
Nagar Nigam Rudrapur	220432	286310	352188	2.00	6.75	21.60
Nagar Palika Parishad Gadarpur	24957	30613	36269	0.04	0.13	0.39
Nagar Palika Parishad Bajpur	29256	32988	36720	0.05	0.13	0.38
Nagar Palika Parishad Kichha	53427	64889	76351	0.02	0.06	0.19
Nagar Palika Parishad Sitarganj	37903	45841	53779	0.02	0.06	0.19
Nagar Palika Parishad Mahuwa Khedaganj	16310	20036	23762	0.42	1.34	4.14
Nagar Panchayat Mahuwadabra	8549	9772	10995	0.03	0.09	0.26
Nagar Panchayat Sultanpur patti	12048	14215	16382	0.24	0.74	2.21
Nagar Panchayat Khelakheda	14076	17223	20370	0.01	0.03	0.10
Nagar Panchayat Shaktigarh	7842	9375	10908	0.02	0.06	0.19
Total				***5.83***	***18.62***	***57.48***

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Table 89. Projected decadal change in Plastic waste generation

Name of ULB	%age Rate of Growth (2021-2031)	% age Rate of Growth (2031-2041)
Nagar Nigam Kashipur	20.96	20.16
Nagar Nigam Rudrapur	23.77	21.98
Nagar Palika Parishad Gadarpur	21.89	20.80
Nagar Palika Parishad Bajpur	19.32	18.94
Nagar Palika Parishad Kichha	21.58	20.59
Nagar Palika Parishad Sitarganj	21.45	20.50
Nagar Palika Parishad Mahuwa Khedaganj	21.94	20.84
Nagar Panchayat Mahuwadabra	19.72	19.25
Nagar Panchayat Sultanpur patti	20.68	19.96
Nagar Panchayat Khelakheda	21.81	20.75
Nagar Panchayat Shaktigarh	21.08	20.25

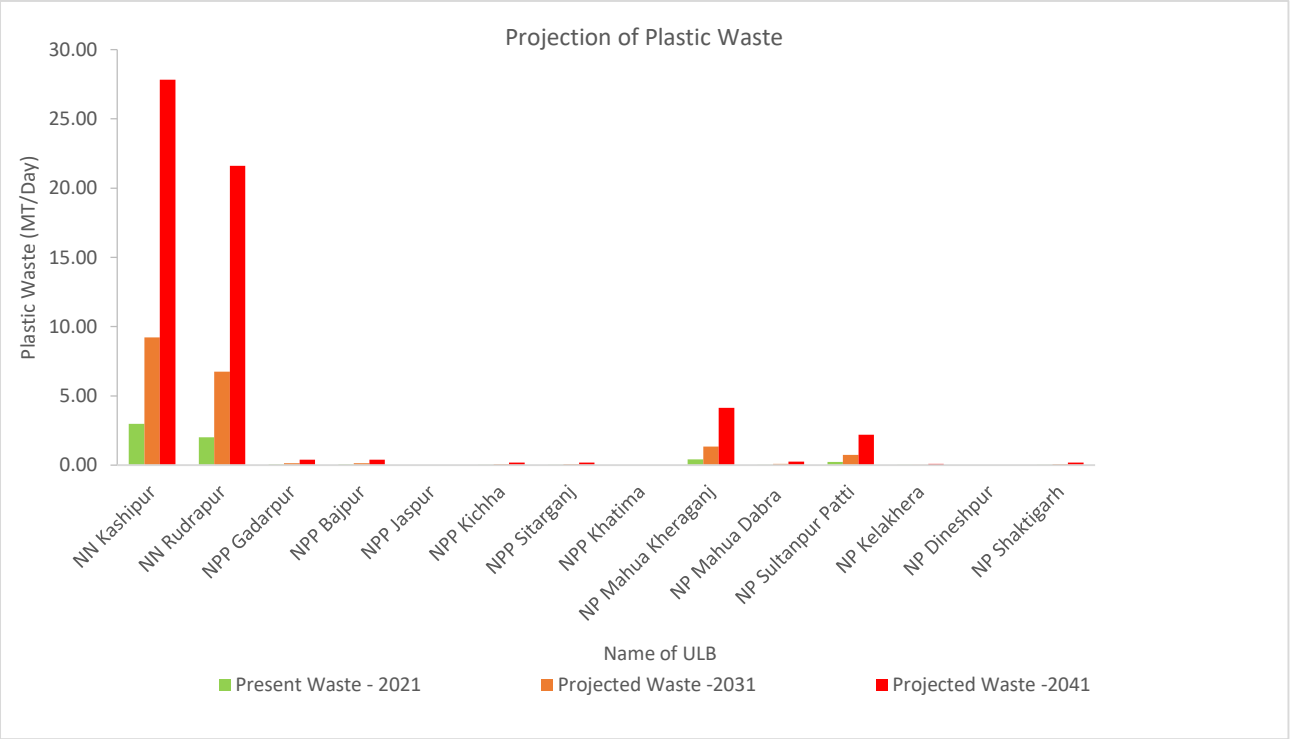

Fig. 6. Projected plastic waste generation

Inferences drawn from plastic waste projection

- Plastic generation in the district is expected to rise in coming decades and would cross 50 MTPD by 2041.
- Amongst all ULBs, NN Kashipur and NN Rudrapur will be major contributors towards plastic waste generation in U.S. Nagar district.
- 20-25% growth rate in plastic waste generation is expected in the decades to come.

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ASSESSMENT OF URBAN LOCAL BODIES IN US NAGAR

In order to push the Urban Local bodies to adopt effective waste management, an assessment of their waste management operations has been carried out. The main objective of this assessment is to let ULBs know their present status regarding various waste management operations in Solid waste management, bio-medical waste management, C&D waste management etc. Based on the adopted methodology, few inferences have been drawn to let administration know about their performance in various indicators (Table 90 & 91).

Table 90. Assessment of urban local bodies in Udham Singh Nagar

Indicators	**Maximum Points**	**Urban Local Body**															
		Kashipur	**Rudrapur**	**Gadarpur**	**Bajpur**	**Jaspur**	**Kichha**	**Sitarganj**	**Khatima**	**Mahuwa Khedagani**	**Mahuwa Dabra**	**Sultanpur pati**	**Khelakheda**	**Dineshpur**	**Shaktigarh**	**Nanakmatta**	**Gularbhoj**
Solid Waste Management																	
Segregation	**4**	2	3	2	0	0	2	2	0	2	2	2	2	2	2	2	2
Collection	**4**	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Segregated Waste Transport	**4**	2	2	2	0	0	2	2	0	2	2	2	2	2	2	2	2
Wet Waste Processing	**2**	2	2	2	2	0	2	2	0	2	2	2	0	2	2	2	2
Dry Waste Processing	**4**	2	2	2	2	0	2	2	0	2	2	2	2	2	0	0	2
Disposal	**2**	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	1
Inclusion of Informal Sector	**1**	1	1	1	1	0	1	1	1	1	1	1	1	1	0	0	1
Bio-medical waste Management																	
Linkage with *Common Bio-medical Waste Treatment and Disposal Facility* (CBWTF)	**1**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hazardous Waste Management																	
Linkage with *Treatment, Storage and Disposal Facilities* (TSDF)	**1**	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C&D Waste management																	
C&D Waste Processing	**1**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E-Waste Management																	
E-waste collection and linkage with recyclers	**2**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
General Information																	
Innovation and use of indigenous techniques	**2**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enforcement of bye-laws and waste Management Rules, 2016	**2**	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Total	**30**	**15**	**17**	**15**	**12**	**06**	**15**	**16**	**07**	**16**	**15**	**15**	**13**	**15**	**12**	**12**	**16**

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Table 91. Final Assessment of Urban Local bodies of Udham Singh Nagar

Name of ULB	Score (out of 30)	Score Percentage (%)
NN Kashipur	15	50.00
NN Rudrapur	17	56.66
NPP Gadarpur	15	50.00
NPP Bajpur	12	40.00
NPP Jaspur	06	20.00
NPP Kichha	15	50.00
NPP Sitarganj	16	53.33
NPP Khatima	07	23.33
NPP Mahuwa Khedaganj	16	53.33
NP Mahuwadabra	15	50.00
NP Sultanpur pati	15	50.00
NP Khelakheda	13	43.33
NP Dineshpur	15	50.00
NP Shaktigarh	12	40.00
NP Nanakmatta	12	40.00
NP Gularbhoj	16	53.33

Observations from data assessment

- Almost all the ULBs have below average performance in waste management operations in the district.
- NPP Jaspur and NPP Khatima are lacking even basic waste management facilities. Hence, a complete overhaul is need of the hour for effective waste management.
- Waste disposal is a matter of concern in U.S. Nagar district. Unavailability of land is exaggerating the situation.

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ACTION PLAN

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Action Plan for Solid Waste Management

Focus Areas

- *Accurate quantification and characterization of waste.*
- *Designated dump site for waste disposal.*
- *Scientific monitoring of disposal site*
- *Linkage with Authorised recyclers*

Despite the fact that Udham Singh Nagar district is one of the major contributors of solid waste in the state, its management is filled with lacuna. The district lacks in all the major aspects of solid waste management from collection to disposal. Scientific management of solid waste is hard to find as most of the ULBs are still practicing traditional solid waste management which has become obsolete. Based on the analysis of data and gaps, this action plan defines areas where each ULB need to work to overhaul their waste management operations (Table92). Each action point is in compliance with the guidelines of Solid Waste Management rules, 2016.

Table 92. Action plan for Solid waste management

Action Point	Concerning ULB	Purpose	Strategy/Approach	Stakeholder Responsible
Estimating quantity of dry and wet waste from total waste	• NPP Khatima • NP Nanakmata	• Determining waste composition in the region. • Ascertaining the need of equipment's and machinery for waste management operations accordingly.	• Appropriate Sampling mechanism as per Municipal solid waste management manual, Swachh Bharat Mission. This will help in getting informal estimate of waste composition in the region. • Double compartment vehicle can be used for waste collection and transportationas executed by NP Shaktigarh. • Establishment of transfer station/Secondary segregation points.	Nagar Palika/Nagar Panchayat
Primary Segregation (Segregation at Source)	All ULBs	• Higher Recovery of Recyclables. • Hygienic environment for handling of waste.	• Separate Storage Bins. • Regular awareness campaigns • Man power Management. • Behavioural change Communication techniques.	• Nagar Palika/Nagar Palika parishad/ Nagar Panchayat • Residents and NGOs

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Segregated Waste Transport	All ULBs	• To reduce open dumping of waste. • Reduction of Historical waste. • To reduce contamination of ground water. • Reduction of transportation charges.	• Optimizing Waste Management Infrastructure (Collection trucks, trolleys). • Man power optimization at Recovery facility. • Use of twin compartment vehicles	Nagar Palika/Nagar Palika parishad/ Nagar Panchayat
Wet Waste Management	• Nagar Palika Jaspur • Nagar Palika Khatima	• Initiating scientific solid waste management. • Eliminating the expense of fertilizer. • Promoting eco-friendly organic fertilizers	• Home compositing • Constructing decentralized composting pits. • Constructing composting pits in dumping site or trenching ground.	
Dry waste Management through waste processing plant/Material recovery facility.	All ULBs except: • Nagar Nigam Kashipur • Nagar Nigam Rudrapur	• Scientific management of dry waste. • Higher waste Recovery	• Establishing Material Recovery facility • Linkage with recyclers	Nagar Palika/Nagar panchayat/Township administrator
Regular waste audit	All ULBs	• To determine changes in waste composition • Ensuring that the ULBs are adhering to MSW rules, 2016.	• A team of expert must be devised to monitor changing waste paradigm in the district.	Nagar Nigam/Nagar Panchayat/Sanitary inspectors
Designated waste disposal site as per SWM rules ,2016	• Nagar Palika Kichha • Nagar Panchayat Sultanpur Patti • Nagar Panchayat Khelakheda	• Reducing local dump sites and heaps of historical waste. • A section of dumping site can also be used for waste segregation and processing as carried out by Nagar Nigam Rudrapur.	• Site selection criteria based on factors such as groundwater depth, land slope, soil properties etc. • Fast tracking transfer of land and other legal formalities.	Nagar Palika/Nagar panchayat
Landfill mining/Remediation of Dump site	• Nagar Palika Sitarganj • Nagar Palika Khatima	• To mitigate environmental impact of waste. (Methane emission) • Resource Recovery of excavated waste.	• ULBs can go through the technique used by Nagar Nigam Kashipur and Nagar Nigam Rudrapur to remediate or clear the dump site. • Rehabilitation through Phytoremediation.	Nagar Palika
Waste recycling	All ULBs except: Nagar Panchayat	• Reducing high health risks associated with	• Registration of waste pickers and recyclers by	Nagar Nigam/Nagar

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through authorised recyclers/Waste pickers	Khelakheda	traditional waste management	ULB. • Cluster based transportation of recyclable waste to the authorised recycler.	Palika
Cluster based approach to Solid waste management	All ULBs	• Clubbing the villages in peri-urban areas of the town with the nearby solid waste management facility for effective waste management in rural areas. • Executing Rurban mission of Government of India.	• By merging schemes from Central and state government department with Rurban Mission of Ministry of Rural development • Roorkee cluster is one such cluster for revamping solid waste management practices. It includes Roorkee, Manglaur, Piran Kaliyar, Landhora, Bhagwanpur and Jhabera	District Administration District Panchayati Raj Officer (DPRO)
Community participation for waste management	All ULBs	• Social and Behavioural Change Communication • Cleanliness drive campaigns throughout the district	• IEC (Information, Education and Communication) activities in Educational institutions. • IPC (Inter-personal communication): School children and Sanitation workers to spread awareness amongst people regarding waste management.	District Administration
Establishment of Green Protocol	All ULBs	• To prevent use of disposables and using alternatives like glass/Stainless steel etc. • To bring generation of non-biodegradable waste close to zero.	• By encouraging Green protocol in local schools, public functions, IEC campaigns, sports events, annual temple festivals and other gatherings.	District Administration

Action Plan for Rural Waste Management in India

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

Maximum population of Udham Singh Nagar lives in Urban areas. Due to this, the villages in periphery of the ULBs are not given much attention. Moreover, amount of solid waste generation from rural areas is unaccounted due to lack of waste management facilities and awareness.

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Nevertheless, both central and state government has come up with some polices which exhibits an array of practicable models for solid waste management in rural areas (Table 93).

Table 93. Proposed policies for Rural Waste Management

Current Policy	Sponsoring agency	Remarks
Decentralized Waste Management	Under Swachh Bharat Mission-Gramin (SBM-G)	Decentralized systems such as household compost and biogas plants shall be encouraged.
Community Sanitary Complex (CSCs)	Under Swachh Bharat Mission-Gramin (SBM-G)	Such complexes comprise of appropriated number of toilet seats, bathing cubicles etc. (Only where there is lack of space in the village for construction of household toilets).
Cluster Approach to Solid Waste Management	Rurban Mission of Ministry of Rural Development	It aims at developing infrastructure and livelihood opportunities in cluster of Gram panchayats that demonstrate economic growth potentials.
Community Participation through 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.

Phytoremediation as a Mitigation Measure (for treatment of solid waste)

Natural or planted vegetation on a landfill has an important role in erosion control and removal of contaminants, besides 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 phytoremediation task (Table 94).

Table 94. Phytoremediation as a mitigation measures (for landfill)

Botanical name	Local Name	Altitude (m)	Assimilating capacity	References
Cassia fistula L.	Golden Rain Tree	100-1400	Absorbs Arsenic and Fluoride from Industrial wastewater	Chaudhary & Rathore, 2019
Morus alba L.	Mulberry	300-2200	Absorbs Zn, Hg, As, Pb, Cu and Cd from Industrial wastewater	Janta *et* al., 2016
Dalbergia sissoo Roxb. ex DC.	Sheesham	Upto 1500	Absorbs nutrients from sludge	Kapoor *et* al., 2013
Calotropis gigantea (L.) Dryand.	Crown Flower	up to 1000	Helpful in absorption of Radioactive elements from soil	Kumar *et* al., 2013
Lemna minor L.	Duckweed	Upto 1200	Absorbs Cr and Pb from water	Kaur *et* al., 2021

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Action Plan for Bio-medical Waste Management

Focus Areas

- *Linkage of ULBs with CBMWTF*
- *Waste Inventorization*
- *Ensure scientific distribution of waste*

Authorised health-care facilities in Udham Singh Nagar are managing the waste in a scientific way. Most of them have linkage with CBMWTF in Gadarpur. Biomedical waste generated from households needs effective segregation and management. This action plan provides holistic approach, which includes governance, infrastructure, training and immunization, services etc. to tackle the unprecedented growth in biomedical waste. Some technological interventions like Plasma waste treatment technology is desired in near future (Table 95).

Table 95. Action plan for Bio-medical waste management

Action Areas	Purpose	Stakeholders
Governance		
Authorisation of all HCFs (Allopathic, AYUSHetc.) by Uttarakhand state Pollution control board (UKPCB).	To ensure compliance with the Biomedical waste management rules 2016.	Uttarakhand state Pollution control board (UKPCB)
Linkage of District level hospitals and Community Health Centres (CHCs) 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
Training and Immunisation		
State level and District level orientation programs for healthcare workers to sensitize them about effective Biomedical waste management.	To ensure proper handling and segregation of biomedical waste in HCFs	Health department
• Setting up of Biomedical Waste Database at State level (specifically for primary health-care facilities) • Training on 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 at rural areas).	Health department

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Immunisation (Tetanus and complete doses of Hepatitis-B) of all hospital staff involved in Biomedical waste management.	To avoid any kind of infection while handling Biomedical waste.	Health department
Services		
Establishing bins and bags at each generation points in HCFs with IEC posters displayed.	• To ensure segregation at each generation point and avoid mixing with MSW. • To spread awareness amongst the people related to biomedical waste management.	Health department
Timely replacement of bags, BMW transfer to collection shed and then prompt lifting to biomedical waste treatment facility from the shed.	To ensure timely disposal of biomedical waste.	Health Department and UKPCB.
Information		
Development of an IT-enabled data management system to keep inventory of waste collection, consumables supply, training programs etc. in HCFs (including PHCs in the district)	To ensure transparency in the biomedical waste management system up to primary level.	Health Department
Display details regarding authorisation, treatment and annual report of all Health-care facilities on website.	To make the information open source and ensure transparency.	Health Department and UKPCB.

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Action Plan for C&D Waste Management

Though it has been told that the C&D waste is being utilized locally for filling and repairing works, the administration still needs to devise some policy framework for C&D waste management. This action plan emphasizes on basic amenities required for the effective management of C&D waste (Table 96).

Focus Areas

- *Identification of dumping zones*
- *Quantification of C&D waste*
- *Setting up of C&D waste processing plant*
- *Framing of bye-laws*

Table 96. 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.	• Transition points must be defined to deposit C&D waste. • 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 should be discouraged by imposing penalties on open dumping.	• All ULBs • Public Works Department (PWD)
Quantification of C&D waste generated	To keep account of C&D waste generated or dumped based on area and type of buildings demolished.	Giving demolition permits to waste generators rather than reconstruction permits.	• All ULBs • Public Works Department (PWD)
Setting up of Construction and demolition waste processing plant	For stacking, crushing, processing and manufacturing of various C&D products	C&D waste processing plant should be setup in proximity to the urban areas of the district.	• Nagar Nigam/Nagar Palika • District administration
Arrangement of Size grading	To facilitate reuse of C&D Waste.	This can be done by erecting sturdy metallic screens of different sizes at an angle and putting the waste over them with the help of front-end	• All ULBs • PWD (Public Works Department)

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		loader.	
Involvement of Private enterprise	Assortment and transportation of C&D waste	Public private partnership schemes must be encouraged	ULBs
Coordination and Collaboration amongst different departments.	To take care of C&D waste in addition to other municipal garbage, if there is no consolidated Solid Waste management department.	Close coordination between Sanitary department, Municipal Engineering Department and Town planning department is required for efficient management of C&D Waste management.	• All ULBs • Public Works Department (PWD)
Framing by-laws for C&D waste management.	To ensure compliance with C&D Waste Management Rules 2016.	• By-laws must be framed by each ULBs as per C&D waste management rule for proper disposal of C&D waste in the district. • Provision of heavy fines should be done under these by-laws for illegal dumping of demolition waste such as excavated earth material on the banks of river or on the hill slopes.	• All ULBs and District Panchayati Raj officer (DPRO) • Public Works Department (PWD)
Plantation in old dumpsites.	Established the slope at old dumping zones.	Plantation at old dumping zone should be done with the help of community participation to stabilize the slope over there.	• All ULBs and District Panchayati Raj officer (DPRO) • Public Works Department (PWD)

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Action Plan for Hazardous Waste Management

Hazardous waste generation in Udham Singh Nagar mostly accounts for the waste generated from the industrial processes and imported from other states/UTs. Basic Hazardous waste management facilities are available in the US Nagar. However, inventorization of hazardous waste generated from domestic households is still an issue. This action plan (Table 97) provides some key areas in which the district needs to work to achieve effective hazardous waste management complying with latest hazardous waste management rules, 2016

Focus Areas

- *Separate coloured bins for hazardous waste/e-waste*
- *Linkage of ULBs with TSDF.*
- *Streamlining of hazardous waste in current waste management operations*

Table 97. Action plan for Hazardous waste

Action Point	Purpose	Strategy/Approach	Stakeholder Responsible
Linkage of ULBs with common Treatment, Storage and Disposal Facilities(TSDF) or disposal facility	To ensure segregation of domestic hazardous waste from municipal solid waste and its proper disposal.	• All the ULBs of the district should establish linkage with nearby common TSDF or disposal facility to ensure proper disposal of hazardous waste to avoid its dumping in the landfill site. • One collection facility should be setup in the district to collect domestic hazardous waste from the rural areas of the district.	• All ULBs • State pollution control board
Training of sanitation workers regarding segregation of domestic hazardous waste.	To ensure proper handling of waste and avoid any kind of infection.	Training programme should be organised at state/district level for handling and segregation of domestic hazardous waste which will also ensure proper segregation of waste.	State government and District Administration
IT enabled systems for inventorization of the hazardous waste.	To ensure compliance to Hazardous waste management rule 2016.	State pollution control board should inventories the generation, collection, and disposal of both domestic and industrial hazardous waste in its website so that complete transparency is maintained in the management of hazardous waste.	State pollution control board

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Action Plan for E-Waste

E-waste generated is not paid much heed and is currently not streamlined in the waste management operations of the ULB. Actual quantification of electronic waste is also unknown.

Focus Areas

- *Doorstep collection of E-waste through toll free numbers or IT enabled interventions.*
- *To stop unregulated backyard operations of e-waste.*

This action plan discusses key areas where due intervention is needed to achieve effective waste management in compliance with E-waste management rules, 2016 (Table 98). Some of the action needs to be addressed immediately such as establishment of collection centre etc. while others can be initiated with the due course of time.

Table 98. Action plan for E-waste

Action Point	Strategy/Approach	Stakeholder Responsible	Purpose
Establishing E-waste Collection Centres	• Collection centre should be established for all ULBs in such a way that they could also cater the collection from nearby rural areas. • A Toll Free Number must be issued for the collection of E-waste	• All ULBs • UKPCB	• To ensure proper segregation of E-waste from municipal solid waste • Capacity building of stakeholders to promote effective E-waste management.
Authorization of E-Waste Pickers	Identity cards should be issued to all the waste pickers.	District administration and ULBs	To avoid illegal trading and processing of E-waste.
Linkage of ULBs with authorized recyclers/ Dismantlers	All the ULBs in the district should establish linkage with any of the five authorized E-waste recyclers.	All ULBs	To ensure proper recycling if possible and if not then proper disposal as per E-waste management rule 2016.
Market survey for identification of brand/producers /bulk consumers. Physical Verification of a Manufacturer.	Regular Auditing of an area by a survey team.	• District administration • UKPCB	To ensure compliance with E-waste management rules, 2016
District level Awareness campaign	• Promoting Information, Education & 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	District administration	Promoting behavioural change in public.

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	E-waste.		
Extended Producer Responsibility	• Random sampling of electrical and electronic equipment's placed on market to monitor and verify the compliance of Restriction of Hazardous Substances(RoHS) provisions as per the guidelines of Central Pollution Control Board(CPCB) • "E-waste Return" Programme should be initiated to incentivize people and bring about behaviour change.	State Government and UKPCB	• Proper Collection and Disposal of E-waste • Channelization of e-waste generated from *the "end-of-life"* products to ensure environmental sound management.

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Action Plan for River Polluter Stretch in US Nagar

As much as 7 polluter stretches in vicinity of major towns have been identified in Udham Singh Nagar. All except Kosi are seasonal rivers which runs dry during lean season, hence waste water from municipal and industrial drains being the only discharge or flow in the rivers during that point of time. Therefore, Scientific management of sewage (through STP/FSTP) is the need of the hour to mitigate the harmful effects of polluted water on human health and riverine ecology. This action plan focuses key points that are required to be incorporated for rejuvenation and restoration of polluted river stretches in the district (Table 99).

Table 99. Action plan for polluted stretches in U.S. Nagar

Action Point	Stakeholders Responsible
Industrial Effluent Management	
Routine/surprise Inspection of GPIs (Gross polluting industries) and Red category industries for ensuring Compliance of effluent discharge standards as prescribed under Environment (Protection) rules, 1986, as amended	• Special Environmental Surveillance Task Force • Uttarakhand pollution control board (UKPCB)
Strengthening of Environment Surveillance squad (ESS)	UKPCB
Monitoring of Drains carrying industrial wastewater and CETP (Common Effluent Treatment Plant) outlet	UKPCB
Sewage Management	
Interception and diversion of all drains	Uttarakhand Payjal Nigam
Installation of STPs for treatment of domestic /commercial waste water in the district.	
Solid Waste Management	
Door to Door Collection of Waste in all 40 wards	Nagar Nigam, Kashipur and Rudrapur
Source segregation of wastes in all 40 wards	
Efficient Operation of waste processing facilities	
Groundwater Quality	
Groundwater quality monitoring at recognized points in the catchment of polluted rivers.	Uttarakhand pollution control board (UKPCB)
Flood Plain zone	
Flood Plain zoning	Irrigation department
Regulation restricted activities in flood plain zones	• Irrigation department • District Administration
Environmental Flow	
Maintaining environment flow(a minimum of 15% discharge in lean period) in river Ganga and its major tributaries	Uttarakhand Jal Vidyut Nigam Ltd.
Green Development	
River training works to prevent soil erosion	Forest department

Source: UKPCB

Phytoremediation as a Mitigation Measure (for rejuvenation of polluter stretches)

Aquatic plants, demonstrate a high potential to purify river water, Industrial wastewater effluents and contaminated water (Samal et al., 2019). The tolerant plants, planted in the riverbank, can purify the river water by absorption, adsorption, accumulation and degradation of contaminants.

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These plants exhibited significant capacity to remove nutrients such as total Nitrogen and Phosphorus from water bodies (Tong, et al 2003). The plant roots provide strong and extensive rhizosphere systems, which facilitate the growth of bacteria and other microorganisms (Steenhoudt, et al., 2000; Zimmels, et al, 2008). These microorganisms play a significant role in the removal of organic and inorganic contaminants from wastewater and contaminated water by degradation of organic chemicals and accumulation of nutrients and other metal contaminants. This phytoremediation process can be applied along either the riverbank or wastewater/storm water discharge point. The technique has low cost and wider community acceptance, irrespective of geographical locations (Table 100).

Table 100. Phytoremediation as a mitigation measures (for polluter stretches)

Botanical name	Local name	Assimilating capacity	Altitude (m)	Remarks
Pontederia cordata		Removal of nutrients and organic matter by aquatic plants and aeration. *P. cordata* has a strong impact on water purification even without concurrent aeration.	< 1000	Anawar et al, 2020
Ipomoea aquatic Forssk.	Water spinach	Removal of TN and TP, *Ipomoea aquatica* (water spinach) has thriving roots and high growth rates and has high capacities to absorb nitrogen, phosphorus, and other nutrients or pollutants		Tang et al, 2020
Persicarialapathifolia (L.) Delarbre		Removal of BOD, COD, nutrient, metal		Rudin et al, 2016
*Canna indica*L.		Ecological floating bed for removal of nutrients		Barya, 2020
Iris pseudacorus L.		Ecological floating bed for removal of nutrients		
Accords calamus L		Ecological floating bed for removal of nutrients		
Typha domingensis Pers.		Decrease in BOD, COD and total organic carbon (TOC) was observed.		Gomber et al, 2013
Leptochloa fusca(Lam.) N.Snow		Decrease in BOD, COD.		
Brassica juncea (L.) Czern.	Sarso	Used to remove As, Pb, and Cd concentration in contaminated soil		Yasin et al, 2021

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Action Plan for Non-Attainment City (Kashipur)

Setting up of a steering committee to achieve target deadlines has been the core strategy to improve the air quality in Kashipur town and its vicinity. The recommended actions can be designated as either policy, regulatory or implementation (Table 101).

Table 101. Action Plan for Non-Attainment city (Kashipur)

Source Group	Action Point	Stakeholders Responsible
Industrial Emissions	Installation and operation of advance air pollution control systems and continuous Ambient air quality monitoring stations in and around Kashipur	UKPCB
	Phasing out Wood and Pet Coke from Industries	
Vehicular Pollution	Restriction on plying and phasing out of 15 years old commercial diesel driven vehicles.	Transport Department and Traffic Police
	Introduction of cleaner fuels (CNG/LPG) for commercial vehicles. Promotion and operationalization of E-rickshaw	
	Integration of all pollution check centres with single web based software for ensuring control and monitoring of polluting vehicles. Periodic calibration test of vehicular emission monitoring instrument.	
• Construction and demolition activities • Road dust	Transportation of construction material like sand ,soil, etc. in covered system.	Nagar Nigam and Development authority
	Restriction on storage of construction material along the road.	
	Water spraying on roads through tankers.	
	Construction of concrete pavements along the roads.	
Public Awareness	Involvement of schools and other academic institution in awareness program.	• UKPCB • Nagar Nigam • Transport Department
	Issuing advisory to public for maintenance and minimise use of personal vehicles.	

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Action Plan for Environment Management in IIA Pantnagar, Rudrapur

Higher CEPI score in IIA Pantnagar, Rudrapur is culmination of Air, Water and land pollution. This action plan focuses on mitigating pollution not only on the core area but also on the 5km impact area around the core area. It has to be done in a stipulated timeline (Table 102).

Table 102. Action Plan for Environment Management in IIA Pantnagar, Rudrapur

Action Point	Responsible Agency	Purpose
Air Pollution		
Installation of Continuous ambient air quality monitoring station (CAAQMS) at IIA Pantnagar.	• SIDCUL • UKPCB	It will help in dissemination of real time air quality information to the general public in display boards
Installation of Continuous Stack emission system.(by the units having investment of more than 100 crores).	• UPCB	To monitor the current emission levels in real time :24 hours a day ,7 days a week.
Prohibition on establishment of new industries which are based on coke and Pet Coke.	• UPCB	This will help reducing pollution as pet coke releases deadly Sulphur dioxide and nitrogen oxide fumes.
Source apportionment Study in IIA Pantnagar and its impact area	• UKPCB	An assessment study to restore the damaged environment. It will help prioritizing the sources that need to be tackled.
Water Pollution		
Quantification of un-accountable discharge at SIDCUL drains. Identification of sources of the drains.	• SIDCUL • UKPCB	This is to make sure that there is only storm water discharge in the drains.
Interception and diversion works of all municipal drains leading to Kalyani river.	• Jal Nigam/Jal Sansthan	It will help in restoration of water quality in Kalyani river. Currently, it is a part of river rejuvenation plan under UKPCB/
Mandatory Sewage Treatment Plants at the units having more than 05 KLD sewage generation(except those connected with CETP/CSTP)	• UPCB • SIDCUL	
Detailed water harvesting and re-use plan in the layout of the plant(Existing must do the same in a time bound manner).	• UPCB • SIDCUL	• Fulfilling the high demand of water for sanitation and drinking purpose for employees. • This will also cut down on carbon footprint by saving the power used in freshwater processing,

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Surface Water quality and groundwater quality monitoring in and around IIA Pantnagar and its impact zone.(On monthly basis).	• UKPCB	It will help ascertain the water quality in the region and making sound decisions on managing water quality for today and future.
Additional Interventions		
Municipal Solid waste treatment facility at IIA Pantnagar.	• SIDCUL	Scientific handling of waste.
Mandatory Green cover (minimum 30 %) in new and existing industrial units.(Lawns, small horticulture /flowering species not to be considered as green belt).	• SIDCUL • UPCB	It can help reduce pollution as plants absorb both gaseous and particulate pollutant.

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Action Plan for Waste Water Management (STPs)

Sewage treatment facility is need of the hour in U.S. Nagar district. Municipal drains are the major sources of water pollution in rivers. Some interception and diversion works are underway in the district which may help in restoring the riverine ecology. This action plan will help in formulating a policy for scientific management of waste water keeping in view various obstacle which may occur (Table 103).

Table 103. Action plan for waste water management (STPs)

Action Point	Concerning ULB	Strategy/Approach	Stakeholder Responsible	Purpose
Continuous Effluent Monitoring station	All ULBs	• Self-monitoring mechanism in the form of Online Continuous effluent monitoring system.	• Jal Sansthan/Jal Nigam • State Pollution control board	• To ensure that the STP meet out the prescribed standards as per Environment Protection Act, 1986.
Decentralized waste water management under Atal mission for Rejuvenation and Urban transformation (AMRUT) by Faecal Sludge and Septage Management system (FSSM)		• In line with National FSSM policy, each state is expected to develop and issue an FSSM implementation strategy and plan guideline. This may be integrated with overall city land use planning. • Capacity building and training on FSSM (at city level) to build their personnel capacities and organizational systems for delivery of sanitation services.	Ministry of Housing and Urban development, Government of India	• Promoting community-planned and managed faecal sludge and septage management for group of households. • Rehabilitation of old sewerage system. • To augment limited treatment capacity. • Recycling and reuse of waste water for beneficial purposes.
City Sanitation Plan under National Urban Sanitation policy	All ULBs	• Enhance synergy among municipal government agencies, the private sector, NGOs and others. • Increase funding from sources other than municipal government (such as from the national and provincial	Ministry of Housing and Urban Development, Government of India	• Citywide Sanitation Sector development. • Awareness generation and behaviour change in field of Sanitation. • Sanitation and safe disposal of waste.

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		governments, donor agencies, the private sector)		
Use and Pay model	All ULBs	By Software as a service (SaaS) integrated platforms.	Jal Sansthan /Jal Nigam	City would pay for per litres of water treated
Automation of all water infrastructures including valves and pipelines	All ULBs	Integration of new age technologies with real time data tracking.	Jal Sansthan /Jal Nigam	To check any malfunction such as leakage, unauthorised connection etc
Integrated Urban Water management	All ULBs	Promoting simultaneous planning of urban infrastructures with decentralised approach for new interventions in parallel to the existing centralised systems.	Jal Sansthan /Jal Nigam	This approach encourages not to look water supply in isolation but in coordination with related sectors such as sanitation ,storm water and rain water conservation and waste water reuse

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Action plan for Industrial waste water management

Two Common effluent treatment plant are currently operational in US Nagar. Other industrial estates have their effluent treatment plant of industrial wastewater management. Some industries are working on Zero liquid discharge in the district. The action plan below focuses on policy level interventions to ensure effective wastewater management in the district (Table 104 and 105).

Table 104. Action plan for industrial waste water management

Action Point	Stakeholders Responsible	Purpose
Guidelines for Conducting Safety Audit as per NGT	• Central Pollution Control Board (CPCB) • (Uttarakhand State Pollution Control Board (UKPCB) Ministry of Environment, Forest and Climate Change (MoEF&CC)	• To mitigate industrial accidents.
Capital subsidies and other forms of Financial support to install ETPs	• Directorate of Industries, Government of Uttarakhand	• Ensuring sustainability of Industrial units. • To encourage a calibrated green focus.
Energy Efficiency in Industrial Sector through Perform, Achieve and Trade (PAT) Scheme.	• Directorate of Industries, Government of Uttarakhand • Uttarakhand State Pollution Control Board (UKPCB)	• To reduce Specific energy consumption in energy intensive structure. • To enhance cost effectiveness of energy saving through certifications of excess savings.
Zero Effect Zero Defect (ZED) Certification.	• Directorate of Industries, Government of Uttarakhand • Uttarakhand State Pollution Control Board (UKPCB)	• To achieve high quality manufacturing that is also green. • To Rate Micro, Small and Medium Enterprises (MSMEs) on quality control and certification for energy efficiency.
• Enforcing over ground and pressurized effluent carrying network • To ban the carrying of effluent up to common collection point through underground and gravity network.	Uttarakhand State Pollution Control Board (UKPCB)	To control unauthorised discharge and subsequently excessive pollutant load at CETP inlet.

Table 105. Common effluent treatment plant management

Action Point	Stakeholders Responsible	Purpose
Dedicated Agency for Effluent Management	Uttarakhand State Pollution Control Board) (UKPCB)	By State pollution control board.
Solid and Salt waste management in ZLD CETPs	Uttarakhand State Pollution Control Board) (UKPCB)	Promote ZLD Technologies that does not result in waste salt and sludge which may cause serious disposal issues

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

Underground water is one of the major sources of water supply in the district. Ground water studies needs to be conducted regularly so that the local authority and people are apprised about the present condition of groundwater in the district. This action plan focuses on the areas, which form the prerequisite for effective water resource management. Each action point complies with the guidelines under Water (prevention and control of pollution act, 1974), (Amendment) Rules 2021 of water resource management act, 1986. The current action points must be addressed in a timeframe of 5-10 year considering the financial constraints. (Table 106 & 107).

Focus Areas

- *Mapping of water scarce areas*
- *Assessment of Groundwater availability in*

Table 106. Water Resources Management

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

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

Table 107. Ground water management

Action Point	**Strategy/Approach**	**Purpose**
Multidisciplinary Approach (Nexus between groundwater, agricultural policy, urban infrastructure and energyconsumption)	By integrated vision and coordination amongst different departments.	For groundwater sustainability
Mapping of aquifer at micro level	By Maintaining an Aquifer information and Management system	• To quantify the available ground water resources • To formulate plan appropriate to the scale of demands and aquifer characteristics.
Designated Idol Immersion Sites within municipal area or bank of river	• By constructing temporary confined ponds with removable synthetic liners at the bottom. • Discouraging use if synthetic material, Plaster of Paris, Baked clay, resin fibres and thermocol for making of idols. • Following CPCB evolved guidelines for immersion of idols and other puja materials in different water bodies.	To prevent any stray immersion of idols in the river or its banks.
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 ground water quality of an area. • To reduce health hazards caused due to contaminated water.

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Action Plan for Air and Noise Pollution

Air pollution has become ubiquitous in U.S. Nagar district, particularly in Kashipur and Rudrapur. This pertains to the large industrial hubs being developed in the region. Air pollution in other areas also needs to be assessed and for that air quality monitoring stations need to be established in all major towns of the district. This action plan focusses on areas, which requires collaborative efforts from different departments to mitigate air pollution in the district (Table 108).

Focus Areas

- *Control on Stubble burning*
- *Vehicular traffic management*
- *Stack Emission Monitoring*
- *Regular Awareness campaigns*

Presently, Noise pollution is not a major issue in the district. However, some administrative level intervention will help to clamp down the nuisance caused due to honking in the district (Table 109). "Operation Decibel" formulated by Kerala could be a better follow up for the same.

Table 108. Action plan for air quality management

Action Areas	Strategies/Approach	Stakeholders	Purpose
Solid waste collection system	• Door-to-Door collection of waste in the urban areas and provision of dry waste collection from rural areas within the district. • After implementing proper collection mechanism, hefty fines must be charged on open burning of waste.	All ULBs and District Panchayati Raj Office (DPRO).	To reduce emission of harmful gases by open burning of waste especially in urban areas.
Vehicular Traffic management	• Checking adulteration of fuel. • Promoting intercity and intra-city public transportation with green fuel alternatives such e-buses etc. • Paving of road shoulders especially in urban areas.	• Department of Police • Transport Department • Public works department	• To reduce emissions caused by vehicles. • To identify area specific vehicular pollution
District level action plan for air pollution	A district level task force with some experts can be formed for air quality management in the district.	District Administration	To improve existing air quality.
Awareness on air quality	Mass awareness can be promoted with Information, education and communication (IEC) activities by involving institutions such as schools and colleges for this purpose.	District Administration	To promote awareness among the masses regarding the issue.
Encouraging CNG and battery operated public transport vehicles	Supporting the applicability of Electric and hybrid buses in following areas: • School Buses, • City Buses, • Tourism, • Company vehicles	District Administration	• To reduce local air pollution • Higher efficiency of electric propulsion system.

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Dust control measures	Following Dust abatement measures need to be taken for mitigating its impact on health of an individual and environment: • Sprinkling of water/fine spray to suppress dust re-suspension • Management of Transport vehicles by Pollution under Control (PUC) compliance. • Dry sweeping of work areas to be discouraged. • Development of green buffer for construction activities site (Preferably shrubs and trees that have low uptake of water.	District Administration	To control dust at source and prevent it from becoming airborne, since suppression is virtually impossible once it has become airborne.
Restriction of heavy driven vehicle in US Nagar during day time	The entry points should be decided for non-entry of the heavy-duty diesel vehicles.	District Administration	• For traffic regulation and mitigating road congestion. • To improve daytime air quality
Social Forestry plantation	• Prioritizing native trees/shrubs and grasses of particular agro climatic zone (as plantation of exotic tree/shrub species often results in low survival rate inferior productivity and higher cost of maintenance). • Integrating green corridor development and management for upcoming highway projects.	District Administration	For environment protection and beautification in urban areas.
Mainstreaming and integrating existing policies and programmes of the National Action Plan on Climate Change (NAPCC) and other initiatives of government of India in reference to climate change	By mainstreaming the initiatives under eight national missions of NAPCC namely: • National Solar Mission • National Mission for Enhanced Energy Efficiency • National Mission on Sustainable Habitat • National Water Mission • National mission for sustaining Himalayan ecosystem • National mission for a Green India. • National mission for sustainable agriculture. • National Mission on Strategic Knowledge for Climate Change	District Administration	For an accelerated implementation of time-bond plans through collaborations.

**Key points for the action areas in this thematic are influenced by NCAP (National Clean Air Programme) report by MoEFCC and Action plan for Air quality improvement of US Nagar by UKPCB*

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Table 109. Action plan for mitigating noise pollution

Action Areas	Strategies/Approach	Stakeholders	Purpose
Traffic management	• 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 the urban areas to reduce noise levels.	• District Administration • Public Works department and ULBs	To ensure noise level within permissible limits.
Complaint redressing system	Online complaint registration and redressal system for noise pollution.	District Administration	To sort out grievances registered by citizens
Mass Awareness	Mass awareness campaigns must be organized with the help of Information, Education and Communication (IEC) activities by taking the help of institutions such as schools and colleges for this purpose.	District Administration	To promote awareness among the masses regarding the health impacts such a Noise induced Hearing Loss (NIHL), high blood pressure, sleep disturbances, heart disease due to noise pollution.

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Action Plan for Mining activities

Sand mining is prevalent in the district and forms a major part of the revenue for state government. However, cases of illegal mining activities have come into notice which may hamper the river profile and exaggerated environmental concerns.

Focus Areas

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

The action plan provided below mainly emphasize on areas, which includes monitoring of the mining operation by using the latest technologies, regular audit of the mining sites and other guidelines as per the Sustainable Sand Mining Guidelines 2016 (Table110).

Table 110. 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 to ensure transparency in the system.	State Government and District Administration	To ensure compliance to Enforcement and Monitoring guidelines for Sand mining, 2020.
Identification of hotspots for illegal mining	The district task force should identify the possible hotspots for illegal mining through surveillance and patrolling.	District Administration	To have check on the mining activities in the district.
Community participation	A toll-free number must be issued for citizens in the district to register any complaint against any illegal mining practices as identified by them in their vicinity	District Administration	• To understand local faction's willingness in curbing illegal mining from the area. • To have local check on the illegal mining activities in the district.

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Action Plan for Rejuvenation of Waterbodies

Rejuvenation works are in progress in all polluted river stretches in US Nagar. Action plan has been prepared for the same by Uttarakhand Pollution Control Board. Apart from this, District administration has been constructing ponds in each block under different schemes such as MNREGA.

This action plan discusses some modalities, which includes scientific interventions as well as convergence activities to revive the flow of any water body and its sustainable management (Table 111).

Table 111. Action plan for Rejuvenation of Water bodies

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 natural resistant to soil disturbances and standing water must be encouraged.	• To reduce shoreline erosion • Particular type of plants act as natural barriers to dissipate waves and back-lying areas from flooding.
Prohibition of disposal of Municipal Plastic waste and Biomedical waste (specially in flood plain zones)	• Awareness and behavioural change activities. • Provisions of heavy fine for those found throwing garbage in rivers.	• To maintain ecological balance of the water body • To prevent pollution activities nearby river basin.
Spring-shed and stream shed management	• By Constructing loose boulder check dams. • Encouraging Information, Education and Communication (IEC) activities in local institutions (schools, colleges etc.)	To improve water resource sustainability To enhance water discharge from springs and rivers
Convergence Activities	By making use of Social media platforms	Ensuring Community participation

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

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Action Plan for Plastic Waste Management

Focus Areas

- *Streamlining of plastic waste in current waste management operations.*
- *Emphasis on Extended Producer Responsibly*
- *Formalization of waste pickers*

Plastic waste causes a plethora of problems when it leaks into the environment. Stranded single use plastics create visual pollution. There is evidence that the toxic chemicals added during the manufacture of plastic, transfers to animal tissue, eventually entering the human food chain. Moreover, by clogging sewers and providing breeding grounds for mosquitoes and pests, plastic bags can increase the transmission of vector-borne diseases like malaria, cholera. Plastic waste management is still not robust in the district. Plastic waste generation is likely to escalate with rapid urbanization in the district. Almost one third of plastic waste generated ends up in river bodies, which has damaged riverine ecology.

There is no separate policy framework for plastic waste management in U.S. Nagar district. In fact, the plastic waste still forms the part of informal economy as it is handled by local waste pickers. Amalgamation of scientific and convergence activities are required for effective plastic waste management in the district. This action plan focusses on key areas which needs to be addressed for plastic waste management in the district (Table 112).

Table 112. Action plan for plastic waste management

Action Point	Strategy/Approach	Stakeholder Responsible	Purpose
Source segregation	• ULBs should distribute separate bins to households, street vendors and other shopkeepers as done by NP Dwarahat. • Distribution of separate bins to every households and shopkeepers in rural areas under Swachh Bharat Mission Gramin should be ensured. • Mass awareness programmes regarding source segregation with the inclusion of institutions such as schools and colleges.	All ULBs, District Panchayati raj Officer (DPRO), Village Panchayats	• To ensure better efficiency in waste processing • Higher recovery of resources.
Effective Collection and segregated waste transport	• Training waste pickers and providing them proper equipment suitable as per the topography of the area for door to door collection in urban areas. • Establishing plastic waste collection centres in rural areas where door to door collection is not possible.	All ULBs, District Panchayati Raj Officer (DPRO), Village Panchayats	• To reduce open dumping of waste • To reduce monkey menace (which is a huge issue in the urban areas of the district)

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	• Provision of separate vehicles is done for dry and wet waste to ensure utilisation of manpower. • ULBs can establish linkage with the NGOs working in this field for effective waste collection in the urban areas.		• To ensure optimum utilisation of manpower • To ensure compliance with plastic waste management rules 2016
Linkage of ULBs & other collection centres with recyclers/ cement plants / Public Works Department	• NP Dwarahat, NP Chaukhutiya should establish linkage with any recyclers as other ULBs of the district already have linkage with some of the recyclers. Plastic waste collection centre to be started in rural areas should also be linked with recyclers. • Plastic waste can be used in road construction for this ULBs should coordinate with the construction agencies such as Public Works Department.	All ULBs, District Panchayati Raj Officer (DPRO),,	• To avoid open dumping of plastic waste. • To ensure reuse and recycle of plastic waste.
Implementation of extended producer responsibility (EPR) through producer/Brand owner	• ULBs can ask the manufacturers collectively or individually in line with the principle of extended producer responsibility (EPR) to provide the required finance to establish plastic waste collection centres.	All ULBs	• To reduce the workload of ULBs
Community participation for waste management	• Information, Education and Communication (IEC) activities in Educational institutions. • Inter-personal communication (IPC): School children and Sanitation workers to spread awareness amongst people regarding waste management	District Administration	• Social and Behavioural Change Communication • Cleanliness drive campaigns throughout the district
Establishment of Green Protocol	• By encouraging Green protocol in local schools, public functions, IEC campaigns, sports events, annual temple festivals and other gatherings.	District Administration	• To prevent use of disposables and using alternatives like glass/Stainless steel etc. • To bring generation of non-biodegradable waste close to zero.

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CONCLUSION

The district of U.S. Nagar is one of the most developed regions in the state. Increase in industrial activities and growth in urban population has posed numerous challenges regarding various environmental aspects such as land, air or water resources. In a majority of the ULBs (10 out of 16ULBs), solid waste management operations like it's processing and scientific disposal are lacking. Some of the ULBs such as NPP Jaspur and Khatima are not even processing the non-biodegradable waste (wet waste) adequately. Scientific recovery of waste and allotment of proper land areas for waste disposal is the need of the hour for effective and sustainable solid waste management in the district. Hazardous waste from the industries is quantified and is managed in Treatment, Storage and Disposal facility (TSDF). But hazardous waste and E-waste from households as well as even government institutions could not be streamlined in current waste management operations. A separate bin or collection centre for these toxic wastes is desired in near future as open dumping of these wastes can be a potential threat to human life. An estimated quantity of 406 kg of biomedical waste is lifted every day from the healthcare facilities to Common Biomedical Waste Treatment and Disposal Facility (CBMWTF) which operates under the consent of State Pollution Control Board. Biomedical waste from domestic households, nursing homes, etc. has been increased in the wake of pandemic situation. Hence, it needs to be managed scientifically to avoid any future outbreak. ULBs need to be linked with local HCFs and build some kind of framework to manage the biomedical waste in a collaborative way. Construction activities are on rise in the district but management of C&D waste is still done in an informal way. This may lead to a false belief that there is no C&D waste in the district. ULBs need to frame some guidelines regarding C&D waste management and need to share in public domain. The district has as many as 07 polluter stretches which have been a cause of great concern for the local administration. Effluents from industrial and municipal drains have been one of the main reasons for deteriorating water quality in these rivers. With due intervention from Hon'ble NGT, action plan is prepared for the rejuvenation of these polluted river stretches. This focuses on short term, intermediate and long-term plan to restore the water reserve and its quality. Moreover, STPs have been proposed under National Mission for Clean Ganga (NMCG) to treat scientifically the waste water accumulated in the drains/nalas. Interception and diversion works have been proposed for the same and major nalas have been tapped. Septage management and co-treatment technologies have been proposed in the district as a part of centralized wastewater treatment. A pilot project (125 KLD FSTP) is being run on this technology in Rudrapur city. As per guidelines of Hon'ble NGT, two CETPs (IIE SIDCUL Pantnagar and Sitarganj) have a

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capacity of more than 7 MLD which are operational in the industrial clusters of the district. As many as 920 industrial units are connected with these two CETPs. Rest of the industries have their individual ETPs and/or are currently working on 'Zero Discharge' policy. Air pollution is one of the biggest issues in the district. Thousands of industries are currently operational in the district. These industries are mainly in Kashipur and Rudrapur cities which contribute massively to the deteriorating air quality in the region. IIA Pantnagar, Rudrapur industrial cluster was declared as critically polluted in 2019 with CEPI score of about 77.7 out of 100. An action plan was prepared as per the directions of Hon'ble NGT to address the issue of rising air and water pollutions in this industrial cluster. Moreover, another industrial city of Kashipur was declared as non-attainment city since it was not fulfilling the standard air quality levels for the past five years. Industrial units, construction activities, burning of solid waste, road dust, etc. have been the major causes of air pollution in Kashipur city. An action plan has been prepared by Uttarakhand Pollution Control Board. This targets specific areas to mitigate air pollution in the city. Air pollution is also a major concern in other parts of the district which is mainly at Rudrapur. This town is also another industrial hub in the state. Four manual air quality monitoring stations have been installed in different locations to ascertain air quality in these two cities. Major rivers in the district are non-perennial and often turn dry during the lean season. Hence, the only discharge during the summer season remains in these rivers which confines to that of municipal and industrial drains. This has hampered the riverine ecology to a great extent. Plants based techniques such as phytoremediation needs to be implied so that some of the amount of toxic chemicals could be absorbed naturally as self-purification process becomes difficult in a dry season. Underground water is the main source of drinking water in the district. Eleven groundwater stations are available to regularly ascertain the draft and quality of underground water. Mining activities, specifically sand mining is ubiquitous in the district. The Bhabar and Tarai regions have rich mining potential and are a major source of revenue for mining department. However, illegal sand mining activities (35 cases registered during financial year 2020-21) have also become prevalent in the district which need due surveillance through manual as well as use of modern technology. It was also ensured that environmental consideration could not be compromised while pursuing mining activities. This can be established by making stringent environmental conditions for clearance and to obtain consent for mining activities.

The district administration and other departments need to come up with practical solutions to address the environmental concerns in the district of U.S. Nagar. Each aspect related to air, water

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and land pollution need to be studied thoroughly so that locally viable and economically feasible solutions could be envisioned.

(Source: B, C & D, Mahuwa Kheraganj, US Nagar)

Fig. 7. Different activities in US Nagar for preparation of District Environment Plan

(A) A consultative workshop/Seminar in the district on preparation for District Environment Plan (November, 02, 2020) (B&C) Awareness campaign in Mahuwa Kheraganj regarding segregation of waste and home composting (D) Door to Door campaign to Aware citizens.

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