

A Call to Action: The Role of Mann ki Baat for Mobilizing Communities to Address Plastic Waste in the Himalaya



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Plastic Waste in the Himalaya

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PREFACE

Plastics have dominated the markets due to their user-friendly properties like durability, strength, longevity, and low cost. Excessive use of the plastic products particularly of the single-use plastic items is producing unprecedented volume of plastic waste but its slow degradation in the environment has emerged as a major cause of physical and chemical pollution. Over the past seven decades, plastic industry has globally outgrown all other competitive industries which has resulted in dumping of plastic in terrestrial and aquatic environments. Microplastics have been reported from diverse habitats like oceans, rivers, lakes, glaciers, urban landscapes, and terrestrial environments. Owing to the emerging challenges of the plastic pollution, global community has started acting towards formulation of an international treaty for combating the plastic pollution. Likewise, nations have also implemented their own regulations and rules for management of plastic waste. India through its Plastic Waste Management Rules, 2016 amended in 2021 and 2022 has imposed a ban on manufacturing, importing, stocking and use of identified single-use plastic items in July 2022. These rules have been imposed strictly across the country and significant change is being witnessed towards elimination of single-use plastic during recent times.

The Himalaya, being one of the world's largest and highest mountain ranges, is home to diverse ecosystems and communities that rely on the region's natural resources for their livelihoods. However, due to the increasing population and tourist footfall even in its remote corners, the region faces an increasing threat from plastic pollution, particularly single-use plastics. The use of single-use plastic items such as plastic bags, bottles, and food containers has become ubiquitous which are often discarded after just one use and can take hundreds of years to decompose, polluting the region's waterways, soil, and air. This proliferation of plastic waste has numerous negative impacts on the Himalayan environment. It poses significant risk to the human health and threatens the region's wildlife. Microplastics have already been reported from all major rivers, lakes and glaciers of the Himalayan region.

Furthermore, the region's geography presents unique challenges for waste management, with many remote communities lacking proper infrastructure to dispose the waste safely. This has led to plastic waste accumulating in sensitive ecosystems like glaciers and river systems, where it can have devastating impacts on the natural balance. To address this issue, many



organizations and governments are working to reduce the use of single-use plastics in the Himalaya through education, policy interventions, and alternative materials. However, these efforts face significant challenges, including limited resources, lack of awareness among local communities, and the need for coordinated action across multiple jurisdictions. In this monograph, we highlight the current state of plastic waste management, policy implementation and people's perception towards elimination of plastic waste in the Himalaya. Particular emphasis has been given on the impact of Prime Minister's Mann ki Baat on people's behaviour towards plastic waste management in the Himalaya. It is noteworthy that the Hon'ble Prime Minister is deeply concerned about the detrimental effects of plastic on the ecology and environment in the ecologically sensitive Himalayan landscape. Hence in Mann Ki Baat Hon'ble Prime Minister has raised this issue for 15 times e.g., on 25th August 2019, 27th December 2020 and 26th June 2022. Mann Ki Baat has had a significant impact on the behavior of societies, users and key stakeholders. The effect is such that people seem to be going back to the 1970s or 80s, when people used to carry household items from the market in stitched cotton bags. There are many examples to cite, needless to mention that people in our country have a positive mindset to adopt something that helps the ecology and environment in a positive way.

Further, we have documented more than thirty good practices from different corners of the Himalaya which have made significant on-ground change towards plastic waste management and thus are source of inspiration to people and governments of the Himalayan states and UTs. We call on governments, organizations, and individuals to work together to find solutions that protect the region's environment and communities, and ensure a sustainable future for this iconic mountain range.

Sunil Nautiyal
Director

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Executive Summary

Plastic waste has increased enormously across the globe during the last seven decades and has polluted the environment through various pathways. To curb the plastic pollution and eliminate Single Use Plastics (SUP) from the country, the Prime Minister of India highlighted the issues in 15 episodes of Mann ki Baat during the last five years. People across the country including in the remote corners of the Himalayan region have been sensitized and motivated to adopt necessary actions and behavioural changes SUPs. Following the ban on manufacture, import and use of identified SUP's in July 2022, all Himalayan states and UTs have formed the task forces to formulate the action plan and have taken necessary regulatory and monitoring actions for elimination of SUPs. Waste management infrastructure has improved significantly and strict monitoring has been ensured including penalties the violators for use of SUPs. In a people's perception survey with more than 1200 respondents across the Himalaya, it was revealed that nearly 75% of peoples have been influenced by Mann ki Baat for adoption of necessary behavioural changes, 96% of which have participated in campaigns for cleanliness of plastic waste in their regions. A large proportion of people (77%) practice recycling of plastic, 80% people are aware ecofriendly alternatives and 87% people are willing to pay higher prices for such alternatives. However, comparatively small portion of the people believed that the current efforts of state governments are sufficient whereas a large (66%) believed that stringent regulations and more intensive monitoring is required to tackle the prevailing problem of the plastic pollution. To understand the level of public participation in the drive against plastic pollution, we documented more than 30 good practices from the Himalayan region and categorized them under three classes i.e., (a) smarter product use and manufacture, (b) extended lifespan of product and its parts and (c) useful application of materials, representing the 9R's which a precursor to a circular economy.

Keywords: Good practices, Himalaya, People's perception, Plastic waste, Plastic regulations, Single use plastic.

Inspired by Mann Ki Baat Episode Nos. 36; 44; 56; 57; 58; 59; 68; 72; 82; 83; 84; 85; 86; 90 and 93, dated 24 September, 2017; 27 May, 2018; 25 August, 2019; 29 September, 2019; 27 October, 2019; 24 November, 2019; 30 August, 2020; 27 December, 2020; 24 October, 2021; 28 November, 2021; 26 December, 2021; 30 January, 2022; 27 February, 2022; 26 June, 2022; 25 September, 2022, respectively.



Waste collection bins placed by the Indian Army in the Siachen valley of Ladakh UT

Background

1.1. History of the plastic industry

Plastic is a summary term typically used for artificial synthetics and polymers. In the 1850s, English metallurgist Alexander Parkes created the first thermoplastic however its commercial success is attributed to American inventor John Wesley Hyatt who produced Celluloid in 1869 (Geyer, 2020a). Cumulative global plastic production before 1950 is estimated to be between 4 and 8 million metric tons (Geyer, 2020b). However, mass production of Plastic was witnessed in 1950 when its production reached nearly 2 Mt in a single year; thus, the year is also considered the start of the Anthropocene era (Zalasiewicz et al., 2016). During these past seven decades of human history, plastics have outgrown and are under environmental scrutiny due to their harmful impacts. Estimate for coastal regions suggests that 275 Mt of plastic waste was generated in 192 coastal countries in 2010 among which 4.8 to 12.7 Mt entered the ocean (Jambeck et al., 2015). Global production of Plastic in 2017 was estimated to be about 8300 Mt of virgin plastic. Around 9% had been recycled, 12% was incinerated, and 79% was accumulated in landfills or the natural environment (Geyer et al., 2017). If the existing trends of production and waste management continue, roughly 12,000 Mt of plastic waste will be in landfills or in the natural environment by 2050 (Geyer et al., 2017).

In India, Plastic was first introduced in 1957 for the production of polystyrene, and by the decade of 1970s, it became a widely used material due to its versatility, durability, and low cost of production. Presently, the Indian plastic industry is a major sector in the country's economy, which employs over 4 million people, with over 2,000 exporters and 30,000 processing units, most of which are small and medium enterprises. India share 6.4% of the global production of 390.7 Mt of plastics in 2021, with a projected use of 160.4 Mt of plastics by 2060 (www.statista.com/topics/6902). India manufactures various plastic products and is a major exporter of plastic raw materials, films, sheets, sacks, fabrics, and tarpaulin. However, the indiscriminate use and disposal of plastics have resulted in significant environmental problems in India. The country generates an enormous amount of plastic waste, much of which ends up in landfills or pollutes waterways and other natural habitats. The Government of India has taken various measures to address this issue, including a ban on manufacture, import and use of identified single use plastic items from July 2022.

1.2. Appeal to the public in Mann ki Baat

Prime Minister of India in his Independence Day speech in 2019 urged the people of India to pledge on Mahatma Gandhi's 150th Birth Anniversary to make the country free of single-use plastic. Later, on 25th August 2019 he again appealed to the people to ensure adequate arrangements for the collection, storage, reuse, recycling and removal of plastic waste from the country. So far, Prime Minister of India has highlighted the issue of plastic pollution or Single Use Plastic (SUP) in 15 of his Mann ki Baat's during last decade and had urged and motivated people towards Swachh Bharat Abhiyan particularly focusing on removal of SUPs. He mentioned the efforts of Mr. Ripudaman Belviji on 29th Sept 2019 who started Plogging campaign in Delhi followed by cross country campaign and story of scuba divers of Vishakhapatnam on 24th Nov 2019 who cleaned thousands of kilograms of plastic garbage from Mangamaripetta beach. He shared two stories on 27th Dec 2020 about Mr. Pradeep Sagwan who has been collecting plastic waste dumped by tourists in different parts of Himalaya and Anudeep & Minusha who set up a unique example by cleaning up the garbage at the Someshwar beach during their first trip after marriage. In 2021, Hon'ble Prime Minister again urged to clean our homes, roads and surrounding to keep our country clean and plastic free. On 26th Dec 2021 he expressed his concerns about the plastic waste pollution in our oceans and mountains. He mentioned the Puneet Sagar campaign undertaken by more than 30 thousand NCC cadets who cleaned the beaches and collected plastic waste for recycling.

During the year 2022 in his Mann ki Baat, Prime Minister of India unveiled the efforts of various people and groups across India who contributed for (i) **Mission Jal Thal** in Srinagar, Kashmir for cleaning of water bodies, (ii) **Mission Clean and Green Kokrajhar** in Kokrajhar, Assam for cleanliness awareness on flyover, (iii) **Clean India Campaign** in Visakhapatnam who promoted cloth bags instead of polythene, (iv) **Mission Beat Plastic** for cleaning of Plastic and polythene in the forest of Ranthambore. He further mentioned the example of Plastic road construction by using Plastic waste from Chittelui river in Aizawl, Mizoram to promote the concept of waste to wealth and organic composting and recycling of the plastic waste in Karaikal, Puducherry. He especially praised the efforts of people for 75 days long **Swachh Sagar – Surakshit Sagar** campaign in Sept 2022 on coastal cleaning in Goa. About



A hoarding to promote cleanliness by Indian Army

5000 NSS cadets collected more than 30 tonnes of Plastic and 20 thousand students took a pledge to inspire people for the campaign. He also mentioned the eight years long efforts of **Youth for Parivartan** campaign to beautify hundreds of places across Bengaluru and **Kabaad se Jugaad** campaign to use iron scrap, plastic waste, old tires and drums for beautification of public places at a low cost in Meerut.

Following the appeal of Prime Minister of India in Mann ki Baat, people across the country have got educated and sensitized towards the urgency of plastic waste cleaning, reuse, and recycling. In the Himalayan states and UTs of India, due to their remoteness and pristine environment,

plastic waste has been highlighted as a severe cause of pollution. Due to an increasing population and footfall of tourists in the pristine and fragile environments of the Himalaya, plastic has caused nuisance even in the remotest places. However, following the appeal of Prime Minister in Mann ki Baat, a significant change in the people's perception has been witnessed in the Himalaya region. Waste management facilities have improved, and people's voluntary actions have been witnessed across different regions of the Himalaya. This report highlights the impact of Mann ki Baat on behavioral changes in people, state of plastic waste management and implementation of recent policies related to the plastic waste management in the mountainous region of the Indian Himalaya.

Policy framework and guidelines

2.1. International regulations and policies

The international community has witnessed a growing involvement in plastic politics during the last decade, particularly for curbing the menace of marine pollution and microplastics. Global policies on plastics are clustered in four categories i.e., production, consumption, disposal, and circular approaches, but a majority of these measures deal with bans on single-use plastic items, although regulations on other items such as Styrofoam, microbeads are also growing (Knoblauch & Mederake, 2021). The International plastic governance has been intensively emphasizing on formulation of regulations through global plastic conventions, particularly for promoting the circular plastic economy (Nielsen et al., 2020). In contrast, early plastic pollution regulations mainly focused on banning specific plastic products. More recent focus has been devoted to the full plastic value chain and adopting a regulation that facilitates the transition toward a circular plastic economy (Syberg et al., 2021). Globally, the first regulatory measures aimed specifically at plastic bags were enacted in early 2000s. These measures gradually expanded during the past two decades, with many countries imposing restrictions in recent years (Knoblauch & Mederake, 2021). Regulations targeting plastic bags encompass limitations on their manufacture, distribution, use, trade, taxation, levies, and disposal after use (da Costa et al., 2020). The breadth of these regulations varies considerably, but the most prevalent form is the prohibition of free retail distribution. As of July 2018, 127 out of 192 reviewed countries (about 66%) have adopted legislation to regulate plastic bags (UNEP, 2018).

The solutions to plastic pollution are complicated, transboundary, and multilateral, requiring a global response from various stakeholders at different levels. Traditionally, the plastic problem was seen predominantly from an ocean-focused and waste-centered perspective but recently increasing evidence of its presence in terrestrial ecosystems, atmosphere, and human matrices, including lungs and placenta, has alarmed the global societies. It has therefore been argued by global scientific community to adopt a new international legally binding agreement that addresses the entire life cycle of plastics, from the extraction of raw materials to legacy plastic pollution (Simon et al., 2021). At the third session of the United Nations Environmental Assembly (UNEA) in 2017, countries joined hands to pass a resolution on marine litter

and microplastics. Later at the fifth session of UNEA 5.2 in February 2021, a historic resolution entitled “End Plastic Pollution: Towards a Legally Binding Instrument” was adopted by 175 nations. The resolution mandates are to develop an instrument by countries that tackles the entire toxic life cycle of plastic, starting from fossil fuel extraction and production to its end-of-life stage. This landmark event is the culmination of numerous movements and consensus among the global governments to acknowledge and tackle the pressing issue of the plastic crisis.

Plastic pollution is harmful not only to the environment and human health but it negatively impacts the environmental, social, economic and health dimensions of sustainable development. To develop a circular plastic economy for least interaction of plastic waste with the environment, 9R frameworks has been proposed which includes Refuse, Rethink, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, Recycle, and Recover (Potting et al., 2017). In terms of scientific research on R framework towards circular strategies of plastic materials, more focus has been given on Recycling, including mechanical recycling, chemical recycling, and DRAM (Distributed-Recycling-and-Additive-Manufacturing). Recover, which is used for mixed and contaminated Plastic, Reduce, which reflects efforts to decrease consumption and Refuse, which involves bio-based plastics, are the other popular fields of research. However, other strategies like Reuse and Refurbish have limited applicability due to limitations of plastic material whereas Rethink, Repair, Remanufacture and Repurpose are newly popularized concepts and are getting consideration in product design, consumer behavior, and perception of circular economy (Sitadewi et al., 2021).

The circular plastic economy has emerged as a widely accepted solution across the globe, focusing on circular transformation in plastic management by keeping materials in use for as long as possible (Huysman et al., 2017). In a circular economy, plastics would be repeatedly re-used and re-purposed to extend their life in a restorative and regenerative manner to prevent plastics from being disposed of in landfills and oceans and promote reduced greenhouse gas emissions (Pathak et al., 2023). Thus, the global community has awakened by the detrimental impacts of the plastic pollution and necessary efforts are being made for formulation of regulations and research for finding alternatives to the conventional plastics. Further, promotion and development of circular economy



Segregation of non-biodegradable plastic waste for its recycling.

for plastic products has recently emerged a central theme for global markets and businesses. New strategies in developing sustainable values chains and market linkages are being adopted to transform the plastic industry into a circular ecosystem.

2.2. National policies and rules

Plastic Waste Management Rules in India were notified in 2016 which have been amended recently in 2021 and 2022. These rules particularly focus on various aspects of plastic waste management like minimizing plastic waste generation, prevention of plastic waste litter, ensuring segregation at source and disposal of segregated waste. In addition, the rules also specify the responsibilities and obligations of the producers, importer and brand owner for reuse, recycling, and end of the life disposal of plastic products. The Plastic Waste Management (Amendment) Rules, 2021 imposed prohibition on manufacture, import, stocking, distribution, sale and use of single use plastic, including polystyrene and expanded polystyrene, commodities with effect from the 1st July 2022. Subsequently, Plastic Waste Management (2nd Amendment) Rules 2022 incorporated requisite amendments on definitions of biodegradable plastic, thermoplastic, and clarification on technical terms like

end-of-life disposal, pre- and post-consumer plastic packaging waste, plastic waste processor, recycler, reuse, use of recycled plastic, waste to energy etc. Further, the amendment also added rules related to the confirmation of compostable plastic materials to the IS / ISO 17088:2021, as amended from time to time and confirmation of biodegradable plastics to the standard notified by the Bureau of Indian Standards and certified by the Central Pollution Control Board.

As per the recent information, Ministry of Housing and Urban Affairs under Swachh Bharat Mission-Urban 2.0 (<https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1907632>) has laid special emphasis on the reduction of plastic waste generation by focusing on source segregation of waste; segregated collection and transportation; the processing of segregated waste; setting up of material recovery facility in all Urban Local Bodies; continuous awareness generation for reducing SUPs and use of substitute products. In addition, a 'Plastic Waste Management Advisory' has been issued capturing the plastic waste management through reduce, reuse, recycle and recovery techniques and an Additional Central Assistance (ACA) is released for establishing Solid Waste Management (SWM) projects in States and Union

Territories (UTs). Further, 'Swachh Survekshan' and 'Star Rating Protocol' have been introduced, which have been aligned with Plastic Waste Management (amendment) Rules 2021 to encourage cities to phase out SUPs.

A national level taskforce has also been constituted for coordinated efforts to eliminate identified SUP items and effective implementation of Plastic Waste Management Rules, 2016. Similarly, all States and UTs have been constituting their respective Special Task Forces for developing a comprehensive action plan to eliminate the identified SUP items from respective states/UT's. While some states have accomplished the task of formulating the State Action Plan for Phasing out the SUPs within a short time other are progressing towards it. Among the 237 manufacturers and sellers for marketing and selling of compostable carry bags and similar products which are certified as alternatives of SUPs by Central

Pollution Control Board as on 27th March 2023, only nine enterprises are from the Himalayan region representing 4 from Himachal Pradesh, 3 from Uttarakhand and one each from Jammu & Kashmir and Meghalaya.

2.3. Policy implementation in the Indian Himalayan region

As a follow-up to the ban on manufacture, import and use of the identified plastic items, all states and UT's are taking steps as per the provisions of Plastic Waste Management Rules, 2016 which includes formation of state and district level task forces to formulate and implement state action Plan for elimination of SUPs. In the Himalayan region, only three states i.e., Himachal Pradesh, Sikkim and Tripura have prepared the State Action Plan for elimination of the SUPs whereas other states and UT's are under the process to implement the provisions.

Table 2.1. Implementation of Plastic Waste Management Rules, (PWMR), 2016 in the Himalayan region after Prime Minister's appeal for elimination of SUP in August 2019.

S. No.	Rule/Policy/ Act/ Notification	State/ UT	Date/ Year of effect
1	Ban on use of plastic bottles and other plastic made objects in government offices and other institutions (Order No.: 40-LA(GAD) of 2020).	Ladakh UT	June 2020
2	District Level Task Force to prepare an action plan for implementation of PWMR, 2016 to eliminate SUP's (Order No.: 76-LA(GAD) of 2021).	Ladakh UT	May 2021
3	District Task Force, Divisional, District and ULB level cells for implementation of PWMR, 2016 to eliminate SUPs (Order No.: 1073-JK(GAD) of 2021).	Jammu & Kashmir UT	October 2021
4	City Level Task Force of Jammu and Srinagar for elimination of SUPs (Order No.: 1363-JK(GAD) of 2021).	Jammu & Kashmir	December 2021
5	Special Task Force and District Level Task Force for taking measures to eliminate SUPs and to prepare a comprehensive Action Plan for implementation of PWMR, 2016 (Order No.: STE-F(4)-2/2008-V-L).	Himachal Pradesh	February 2022
6	Action Plan for elimination of identified SUP's in Himachal Pradesh.	Himachal Pradesh	2022
7	Ban on manufacturing, import, sale and use of plastic items in the state with provision of penalty to the violators (Order No.: 84/XXX-VIII-I-20-13(II)/2001).	Uttarakhand	February 2021

8	Ban on sale and use of plastics having less than 50 microns thickness and SUP items in all forms vide Notification (Order No.: 08/RM&DD/San).	Sikkim	August 2019
9	Ban on use, manufacture, import and sale of plastic water bottles of capacity 2 litres and below (Order No. 135 /GOS/F&ED/ PC-CF-ACS).	Sikkim	January 2022
10	Mandatory registration of all MSME on Centralized Extended Producer Responsibility portal for plastic packing (Order No.: 2014/SPCB/2743).	Sikkim	March 2022
11	Thickness of plastic carry bags increased from 50 to 75 microns (Order No.:2014/SPCB/6194).	Sikkim	September 2022
12	Thickness of plastic carry bags increased to 120 microns (Order No.: -/SPCB/6163 dated 10-3-2022).	Sikkim	December 2022
13	State level Advisory committee constituted for the purpose of effective Monitoring and implementing PWMR, 2016 (State Gazette: No. 334, Vol. XXVI; Order No. (Env)-93/2019/1674-89).	Arunachal Pradesh	August 2019
14	Ban on SUP items less than 50 micron in Aizawl Municipal Corporation, Mizoram (State Gazette: RNI No. 27009/1973).	Mizoram	August 2019
15	Special Task Force for preparation of comprehensive plan for elimination of SUP's (Order No.: B.11013/7/2020-FST).	Mizoram	March 2022
16	Manipur Plastic Policy, 2022 and Action Plan for effective management of plastic waste and complete elimination of SUP's (Notice No.: MM-102/5/2021 -FE-Dept (For & Envr.).	Manipur	June 2022
17	Prohibiting production, stocking, distribution, sale, and use of SUPs (Order No.: B/17011/7/PMW/2022)	Manipur	February 2022
18	Ban on manufacture, import, stock, distribution, and use of plastic carry bags in the state (Order No.: MSPCB/PWM-2/2019/2021-22).	Meghalaya	February 2022
19	Ban on use and manufacturing of SUPs (Order No.: NPCB-Plastic-3/4256).	Nagaland	March 2022
20	Special Task Force for preparation of comprehensive plan to phase out SUP's (Order No.: F8(30)/DSTE/Env/Pt-IV/3456-63).	Tripura	May 2021
21	Comprehensive Action Plan for phasing out SUP in Tripura	Tripura	June 2022

Process for collection and assessment of data

Recently enforced national regulations on plastic waste management and the appeal of the Prime Minister of India to the people have remarkably increased the momentum of the campaign for a plastic free India. The state/UT governments have established the Task Forces to formulate a state action plan to implement the SUP ban. Urban local bodies have initiated the work to achieve these goals across India's Himalayan states. To understand the implementation of regulations, the current state of awareness and voluntary actions by people following steps were taken in different states/UT's of the Indian Himalayan region.

3.1. Assessment of plastic waste management

A comprehensive review was conducted on the

enforcement and implementation of regulations related to plastic waste management at the National level and for different states/UT's in the Himalayan region. The CPCB web portal on Single use Plastic Items Banned (<https://supwmdashboard.in>) was consulted to review of the status on the development of state level task forces and formulation of action plans for the elimination of single use plastic. In addition, local government, state pollution control boards and local urban bodies were also interviewed to collect information on the implementation of state level action plans. Local urban bodies were consulted for documenting the measures being implemented for removal of SUPs across major towns and cities in the Indian Himalayan region. Further, data on collection mechanism and different incentives for elimination of plastic waste by different Urban Local

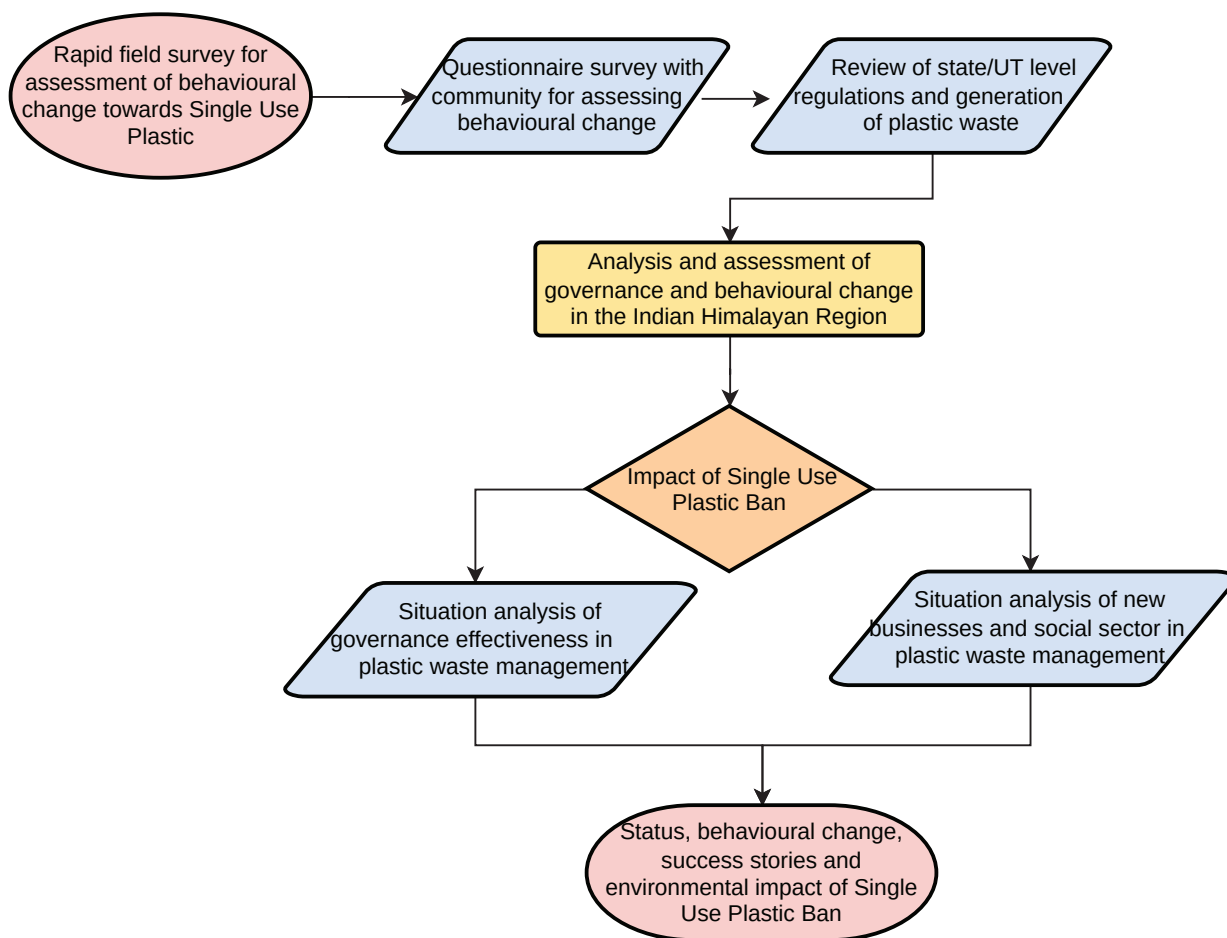


Figure 3.1. A flowchart of methodology adopted for assessment of behavioral change and governance effectiveness towards plastic waste management in the Himalaya.

Bodies were also documented.

3.2. Assessment of behavioral change

Questionnaire survey for behavioral change assessment

To quantify and assess the implementation of the regulation and voluntary actions by the Himalayan people, a rapid questionnaire survey was conducted at representative locations in different states and UT's. An online google questionnaire was designed with question related to various regulations, voluntary actions, people's awareness and perception towards SUPs and general plastic waste in the Himalaya. Behavioral changes in different demographic strata, including age groups, gender, occupations etc. was assessed through this survey. Special emphasis was given to the behavioral changes after the appeal of the Prime Minister on 25th August 2019 and later during Mann ki Baat episodes from time to time. In addition, questions related to people's daily routines for plastic waste management, including refuse, reuse, recycle, willingness to pay for bioplastics, awareness about plastic management regulations, people's participation in campaigns etc. were asked to various groups of the people in the Himalayan states.

Focal Group Discussions

Focal Group Discussions were held with various stakeholders and groups like shopkeepers, tourists, market associations, students and teachers, local communities etc. for conducting an open-ended general discussion. Efforts were made to document the level of awareness regarding

the recently enforced ban on SUPs and Plastic Waste Management Rules 2016 amended in 2021 and 2022. Further, people were also asked about the traditional and modern alternatives of the SUPs, and their frequency and intensity of use. Participants in the discussion group were also enquired about voluntary action ever taken by the people in the towns and cities of the Himalayan region.

3.3. Documentation of Good Practices

Various resources including print media, newspapers, research articles, Mann ki Baat episodes, enquiry with people etc. were consulted to identify and document good practices being implemented by different people, voluntary groups, and other stakeholders in the Himalayan region. People and voluntary groups taking actions to eliminate plastic waste particularly SUP were consulted, and details were obtained on such actions. All such stories were later categorized as per the 9R framework i.e., Refuse, Rethink, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, Recycle, and Recover. All such actions were associated with the appropriate R and good practices under each R were summarized to understand the action being taken with reference to the respective action. Alternatives to the SUP currently being supplied to the markets and manufacturer of such alternative like bioplastics and other ecofriendly products were also reviewed. All such practices were summarized under 9 different R actions to understand the spatial distribution and cumulative impact of such actions in the Himalayan region.



Recording People's perception towards the elimination of single-use plastics in the Himalaya

Impact of MKB on reduction in plastic waste

Plastic products have become an integral part of our daily life and India generates 15 million tons of plastic waste every year but only one fourth part of it is recycled. This leads to burden on the landfills and poor socio-economic conditions of the waste pickers, mostly women. India is committed to act for mitigation of pollution caused by littered SUPs. Considering the adverse impacts of littered plastics, Plastic Waste Management Rules, 2016, amended in 2021 and 2022 prohibits identified single use plastic items which have low utility and high littering potential. The states and UTs in the Indian Himalayan region are making sincere efforts for stringent enforcement of the rules and development of better waste management facilities. A summary of current scenario of plastic waste management in the Indian Himalayan states/UT's is presented here.

4.1. Plastic waste in Uttarakhand

In Uttarakhand, plastic waste is collected from the households (as a part of dry waste) as well as litter bins stationed by the municipalities in each district. Unsurprisingly, its quantity is large in the plains when compared to other topographical divisions within the state. This could be due to the fact that proliferation of plastic waste goes hand-in-hand with growing urbanization and development. As a part of its management, recyclable plastic waste is compacted and bailed (in MRF) before it is finally directed to an authorized recycler or local rag-picker or both. Some districts in the hilly region still lack any linkage to transfer the plastic waste to the authorized recyclers, while others have earned revenues by selling the plastic waste. The present status of plastic waste collected in each district by Authorities are given in Table 4.1. The estimated plastic waste generated in the state of Uttarakhand is 25,202 ton, 18,647 ton and 44,924 ton in the year 2019-20, 2020-21 and 2021-22, respectively as per the UKPCB annual reports.

In Uttarakhand 42 ULBs are segregating, channelizing and sending the plastic to recycle using installed plastic compactor and 06 more compactors are in the process of installation. Achievement of this target would enable all 91 ULBs i.e., 100% facility of plastic recycling. In addition, the government has allocated Rs. 5.2 crore to Panchayati Raj for procuring 95 plastic compactors to be installed at 64 identified Gram Panchayats. During April 2019 to March 2021, approx. 23091.4 ton of plastic waste was collected by

Producers, Importers and Brand Owners (PIBO's) among which 16437.9 tons was recycled and 6653.5 ton of plastic waste was co-processed. Prominent PIBOs in Uttarakhand include Indian Pollution Control Association (IPCA), Shakti Plastic Industries, Shukla e-waste processor, GEM, NEPRA, Green Plastic Waste Management Pvt. Ltd., Rekart Innovations Pvt. Ltd. etc.

Further to strengthen the plastic waste management in the state, 10 MTPD plastic processing units "Plastic Fuel" are being proposed in Haridwar on PPP mode. Further, 05 megawatt "Waste to Energy" plant is proposed at Roorkee to utilize the RDF of nearby Town (Roorkee, Haridwar and Rishikesh). Use of waste plastic in road construction has already initiated on trial basis in 03 ULBs (Haldwani, Almora and Dehradun). A Material Recovery Facility (MRF) having capacity of 05 ton per day is functional at Dehradun and 03 additional MRF's are in the process of establishment. Uttarakhand is home to several manufacturing industries, including pharmaceuticals, textiles, and automobile parts. The state government has also been actively promoting the development of new industries, including food processing, herbal and aromatic plants, and information technology. In terms of recycling, several initiatives are underway in Uttarakhand to encourage the recycling of waste materials, including plastics (Table 4.2).

4.2. Plastic Waste in Himachal Pradesh

The government of Himachal Pradesh enacted its first Non-Biodegradable Garbage (Control) Act in 1995, launched 'The Sustainable Plastic Waste Management Plan' in 2009 and prohibited the use of plastic cups and plates in 2011. The plan focuses on controlling the use of plastic and developing a systematic disposal mechanism. The initiatives aimed to establish environment friendly plastic waste disposal solution while ensuring its sustainability and continued community participation and environmental awareness among local people. The plan was implemented under three stages in the state with the key stakeholders like; revenue department, forest department, tourist department, PWD, panchayats, urban local bodies, NGOs, mahila mandals/youth clubs/citizens, students, rag pickers and people of the state.

Creating and enabling framework

It aimed to adopt a replicable and sustainable solution in which process of household waste to cement kilns and use of same in road construction was done. The Public Works

Table 4.1. Plastic waste generation from Urban Local Bodies in the year 2021-22

Topographical divisions	Name of District	Inventory of plastic waste		Recovery of recyclable plastic waste	
		Quantity of plastic waste generated (MTPD)	Percentage share in dry waste (%)	Through authorized recyclers	By local rag pickers/ kabaddis
Plain Region (Bhabar & Terai)	Haridwar	17.2	18.18	Space Society Midass Greentech	Plastic waste is often sold to local rag pickers in some municipalities of the districts.
	US Nagar	6.27	7.08	Recycling unit at Haldwani	
Mixed Topographical region	Dehradun	38.18	15.51	Aakash Enterprise, New Delhi Waste Warriors Society	
	Pauri Garhwal	9.063	23.54	No linkage with any recyclers	
	Nainital	10.652	13.18	Nivaran Seve Samiti, Haldwani	
	Champawat	0.65	7.82	Recycling facility at Haldwani	
Mid hill	Tehri Garhwal	2.40	17.18	No linkage with any recyclers	
	Rudraprayag	0.16	3.76	K.K. Traders NEPRA Group	
	Bageshwar	1.05	19.09	No linkage with any recyclers	
	Almora	4.05	35.37	Each ULBs has direct/ indirect linkage with authorized recyclers	
High Hill (Border areas)	Uttarkashi	0.91	9.68	Recycling facility at Rishikesh	
	Chamoli	1.54	14.92	K.K. Traders New India traders	
	Pithoragarh	4.19	25.4	No linkage with any recyclers	
Total	96.315				

*Plastic waste is a part of dry waste generated in each ULB/District. (Compiled from GBPNiHE-UKPCB report on District Environment Plan for Haridwar, US Nagar, Dehradun, Pauri Garhwal, Nainital, Champawat, Tehri Garhwal, Rudraprayag, Bageshwar, Almora, Uttarkashi, Chamoli and Pithoragarh).

Table 4.2. Number of registered manufacturing/recycling units (Including multilayer/ compostable plastic units in Uttarakhand

Registered manufacturing/recycling units	Year		
	2019-20	2020-21	2021-22
Plastic unit manufacturers	03	07	09
Plastic unit recyclers	30	46	32
Compostable plastic units	02	01	01
Multilayer plastic units	28	28	24

Department and Department of Environment, Science and Technology jointly demonstrated the pilot near Shimla in road construction towards the solution adoption. The pilot demonstrated it was cost-effective, replicable and provided a solution to utilise plastic waste in innovative way. Further, DEST developed a comprehensive plan for identification of roads, collection, storage and shredding of plastic and PWD was trained on the technology part. This cost effective technology allowed saving of approximately Rs. 35,000 to 40,000 per km through reduction in bitumen use.

Focus on creating awareness through campaigns

In 2nd stage, Government launched Polythene Hatao Paryavaran Bachao campaign. The campaign created awareness and encouraged the participation of mahila mandals, urban local bodies (ULBs), NGOs, associations of Panchayati Raj Institutions etc. Plastic waste was collected from hill slopes, forest areas, rivers, drains etc, and IEC activities, such as video clippings and documentary films, were used to sensitise the public. In this phase, 142 tons of polythene was collected from 10 districts for use in road construction.

Consolidation and sustainability

In 3rd stage, campaign addressed the need to develop sustainable mechanism for collection, disposal and responsibility allocation to different departments. Role allocation, monitoring, team constitution, eco club involvement, public awareness, imposition of fine/penalties were done. In environmental audit scheme was started to monitor the environmental performance of the project as well as facilitate trainings to students, teachers and citizens. Other initiatives that strengthened the campaign were collection of plastic packaging materials, installation of water purifier, replacement of plastic

pouches by glass bottles etc.

4.3. Plastic waste in Jammu & Kashmir UT

Jammu & Kashmir UT constituted the district level task force and divisional, district, ULB's, and city level cells in 2022 for formulation of action plan to implement Plastic Waste Management Rules, 2016, for elimination of SUPs. UT's Pollution Control Committee (PCC) has intensified its campaign against the banned material in a mission mode by holding mass awareness campaigns, cleanliness drives and providing alternatives to public. A campaign during June 2022 focused on cleanliness drives and distribution of cloth bags for one month during which approx. 1.29 tons of plastic waste was collected. Besides, providing alternatives for polythene to public, awareness was created regarding ban on the identified SUP items with effect from July 1, 2022 like ear buds with plastic sticks, plastic sticks for balloons, plastic flags, candy sticks, ice cream sticks, polystyrene for decoration, plates, cups, glasses, cutlery such as forks, spoons, knives, straw, trays, wrapping or packing films around sweet boxes, invitation cards, and cigarette packets, plastic or PVC banners less than 100 microns, stirrers. Further, PCC has intensified seizure drives against illegal use / stocking / sale of banned SUP items including banned polythene carry bags below 75 microns. So far PCC has seized approx. 1812 kg of polythene carry bags and approx. 304.6 kg of SUP since April 2022, which includes seizures from vendors and hot spot areas like bus stands, railway stations and warehouses. Information obtained from Jammu Municipal Corporation indicated that no provision were available before 2019 for recycling however after the Prime Minister's announcement for elimination of SUP in 2019, recycling of plastic waste has been started intensively to curb the plastic pollution.

Table 4.3. Year-wise Municipal Solid Waste generated, processed and recycled in Jammu Municipal Corporation, from 2017-2022.

	Waste Generation (quintals/year)	Waste Processed (quintals/year)	Percent	Waste Recycled (quintals/year)
2017	10,03,750	0	0	0
2018	10,58,500	0	0	0
2019	11,68,000	29200	2.5	0
2020	12,33,700	146000	11.83	29,200
2021	12,48,300	146000	11.70	29,200
2022*	4,36,800	60000	13.74	9,600

4.4. Plastic Waste in Ladakh UT

In Leh before 2021, the solid waste including plastic waste was dumped in an open site at BomGuard outside the township area. Consequently, people of nearby places were facing issues of unmanaged waste littering, enhancement of scavenging animals, foul smell, etc. To address the issue, the Municipal Committee Leh (MCL) in collaboration with Ladakh Autonomous Hill Development Council (LAHDC) Leh installed a 30 tons/day capacity Solar Power-based Solid Waste Management Plant. Subsequently, Leh became the first city in India to have developed a fully solar-powered waste processing facility that processes

90% of its solid wastes. The self-sustaining solid waste management facility, which also manages plastic wastes, operates at a capacity of 30 tons per day in 2020. Presently, the non-biodegradable solid waste including plastic waste is segregated and compacted for sale in the Solid Waste Management Plant, however, biodegradable wastes (food, etc.) is being standardized for making bio-compost. Total solid waste generation in Leh district was 16,160 quintals from urban and 20,918 quintals from rural areas during 2021-22, out of which 1387 quintals and 752 quintals of plastic waste was recycled respectively (Table 4.4).

Table 4.4. Recycled non-biodegradable waste (quintals) in Leh district during 2021-2022.

Source	Paper	Plastic	Glass	Metal	Rubber	Ceramic	Others	Total
Urban waste	801.37	417.10	-	63.00	-	-	105.5	1387.0
Rural waste	402.63	288.95	-	52.94	0.90	-	6.7	752.2

4.5. Plastic waste in Sikkim

In Sikkim, plastics constitute 17% of the total solid waste and its waste production has reduced from 102.7 ton in 2016-17 to 82.75 ton in 2020-21 (Table 4.5). Sikkim government, became the first Indian state to ban the plastic carry bags in 1998. The inspiration for the state-wide ban on plastics came from a tiny village named – Yuksom, a village located beside the Khangchendzonga National Park. Local communities came together by forming Khangchendzonga Conservation Committee (KCC). It immediately took the issue of garbage management within the national park, especially single-use plastics. KCC collected around 800 kg of waste from trekking

trails and forests. It has established strict rules by which trekking operators have to declare non-bio-degradable waste products being carried through. They have to make a checklist of such items and return account for these products. In 1996, Yuksom became the first village in Sikkim, and probably in India also, to ban the use of plastics like bags and bottles. Later, the sale and use of disposable items such as cups, plates, spoons, containers etc. made from Styrofoam was banned in 2016 by the state government. Further, the state government imposed a ban on use of plastic packed drinking water bottles during any government meetings and functions. Sale and use of plastics having less than 50 microns thickness and SUP



Solar power-based solid waste management plant at Leh, Ladakh UT

items in all forms were also banned in 2019. Thickness of plastic carry bags was increased to 75 microns in 2021 and to 120 microns in 2022. The State Government imposed a ban on use, manufacture, import and sale of plastic water bottles of capacity 2 litres and below w.e.f. 1st January 2022. Government notifies the Plastic Waste Management Amendment Rules, 2021, prohibiting identified single use plastic items by 2022. It was also made mandatory to register all the MSME on Centralized Extended Producer Responsibility portal for plastic packing. The Sikkim State

Pollution Control Board, regularly conducts sensitization programme, trainings and workshops on municipal solid waste management for Urban Local Bodies on plastic waste management. Such programmes were organized across the states such as Karfector, Namchi, Gangtok, Martam, Geyzing, Naya Bazar-Jorethang, Rangpo, Singtam, Mangan etc. Volunteers were also trained for the field and market surveys to assess the availability and use of single use plastics.

Table 4.5. Plastic waste generation in Sikkim.

S. No	Year	Generation of plastic waste (In Tons/year)
1	2016-17	102.7
2	2017-18	199.2, Data for Gangtok Municipal Council are not available
3	2018-19	11.32, Data for Rangpo Nagar panchayat and Gangtok Municipal Council are not available
4	2019-20	69.02
5	2020-21	82.75

Behavioral changes in communities

5.1. People's perception towards use of plastics

Through consistent efforts of the Prime Minister of India to curb the menace of plastic waste, a deep sense of responsibility has been imbibed in different sections of society across the country. The Indian Himalayan region covering 9 states, 2 Union Territories and 3 hill districts of two states i.e., West Bengal and Assam is endowed with a biologically fragile and culturally rich landscape. The Himalaya with a resident population of more than 50 million is also a popular tourist attraction which adds significant pressure on the environment of these mighty mountains including in the form of plastic waste. Millions of tourists visit the region including in the remote and high-altitude areas due to its cultural importance in pilgrimage and the scenic beauty of diverse landscapes. Thus, the daily activities of a large population in the Indian Himalaya generate an unprecedented volume of garbage including the plastic waste. This problem was more severe due to irresponsible behavior of the people until recent past before the start of the Swachh Bharat Campaign and fight against SUPs. However, the ongoing national campaigns on curbing the menace of garbage and plastic waste has influenced human behaviors in a compelling manner. Local government and authorities have stringently implemented regulations on plastic waste management across the country including the Himalayan region. Similarly, voluntary organization, groups and

individuals have been implementing innovative ideas and efforts to promote the cleanliness and removal of plastic waste from the environment.

We conducted a quick perception study in April 2023 through a questionnaire survey of 14 questions (Table 5.1.) related to the plastic waste and SUPs. Both online and offline surveys were conducted using of a google questionnaire and field visit to different markets, tourist places, educational institutions, restaurants, hotels, and common spaces in towns like Leh, Manali, Kullu, Srinagar, Almora, Gangtok, Itanagar etc. in the Himalayan region. A total of 1245 respondents participated in this survey including a highest of 570 respondents from Uttarakhand followed by 190 from Himachal Pradesh, 105 from Ladakh UT, 101 from Sikkim and 209 from other eastern Himalayan states. The survey also included a total of 70 tourist respondents who were currently visiting different states of the Himalaya. The respondents included 52.3% males and 47.7% females. Among the respondents, maximum participation was witnessed from the youth particularly within the age group of 20-24 years and broadly within the age group of 12-28 years (Fig. 5.1a). In terms of occupation of the respondents, 63% were either students or researchers, 18% represented farmers majority of which claimed they are unemployed, 12% shopkeepers and 7% from the service sector (Fig. 5.1b).

Table 5.1. List of questions asked during people's perception survey related to plastic pollution and removal of SUP in the Indian Himalayan region.

S. No.	Questions
Q1	What is the main source of plastic pollution in your area?
Q2	Do you think there should be stricter laws and regulations in place to prevent the use and disposal of plastic in your village/city/region?
Q3	Have the Prime Minister's Man ki Baat encouraged you to reduce the plastic waste?
Q4	Have you participated in any clean-up drives in your area/ Himalayan region?
Q5	Do you recycle plastic waste in your household?
Q6	Do you carry your own reusable bags/containers when shopping?
Q7	Do you actively try to reduce your consumption of single-use plastic products?
Q8	Have you ever used or purchased eco-friendly alternatives to plastic products?

Q9	Have you ever raised your voice against the use of plastic in your community or workplace?
Q10	Would you be willing to pay extra for products that are eco-friendly and mitigate the threats emerging from plastic pollution/ danger of PP?
Q11	Are you aware of plastic pollution and the impact it has on the environment?
Q12	Do you know about schemes that are in place to reduce plastic pollution?
Q13	Do you help at all with reducing plastic pollution?
Q14	Do you think that state government's effort is enough to tackle plastic pollution?

Depending on the demographic structure and economic conditions, different regions have different sources of plastic waste. As per the opinions of the respondents, major source of plastic waste in the Himalayan towns and villages are grocery stores as they contribute the SUPs to the costumers which ultimately is littered around in the environment (Fig. 5.2). Other prominent sources of plastic waste are households and roadside vendors. In contrast, restaurants were claimed to generate minimum plastic waste particularly in the form of littered plastics (Fig. 5.2). In response to the question on need of strict laws and regulations for elimination of SUPs, majority of the

respondents felt such needs whereas a very small portion (8.5%) replied in negative as they believed plastic can be managed even with behavioral changes and availability of waste management facilities (Fig. 5.3, Q2). When asked if the Prime Minister's Mann ki Baat has impacted your behavior towards refusal or reduction of SUPs, nearly 75% respondents acknowledged the change (Fig. 5.3, Q3). In the follow-up question to ask if you have participated in any plastic cleanliness campaign, 96% of the respondents who acknowledged the behavioral change, also declared that they have participated in such campaigns in their regions (Fig. 5.3, Q4).

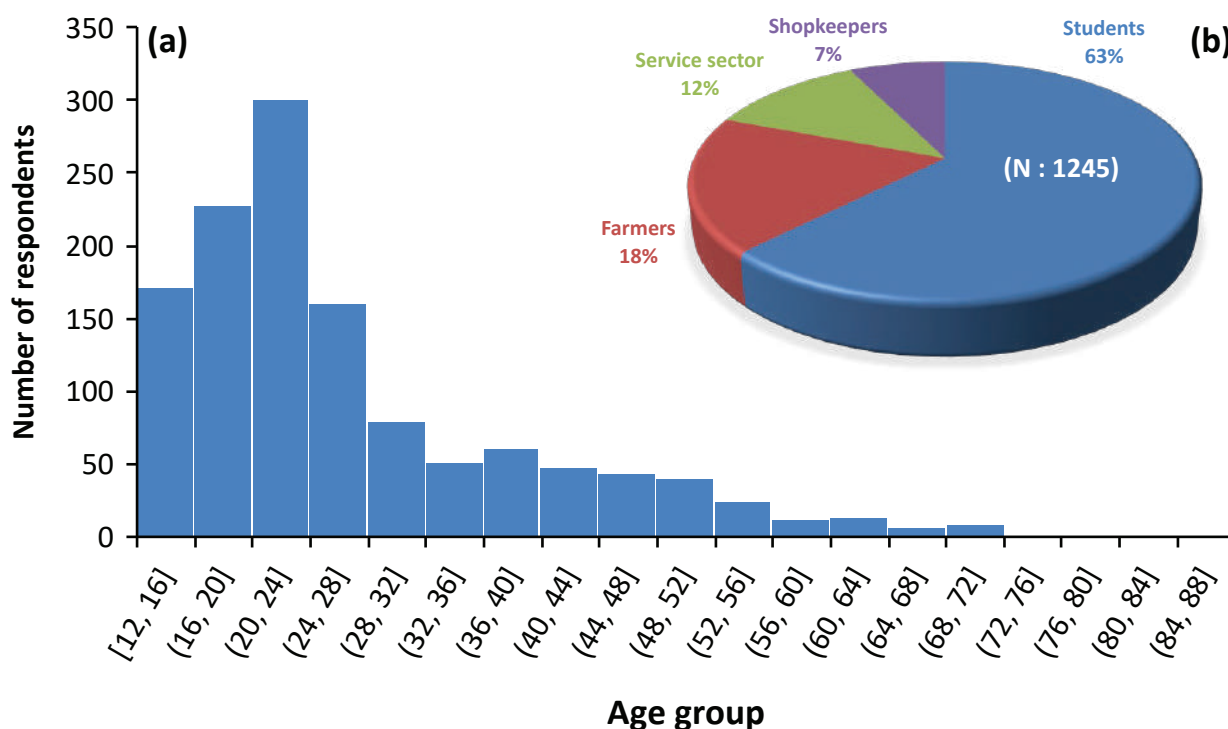


Figure 5.1. (a) Distribution of age group and (b) occupation during of the respondents involved in the questionnaire survey across the Indian Himalayan region.

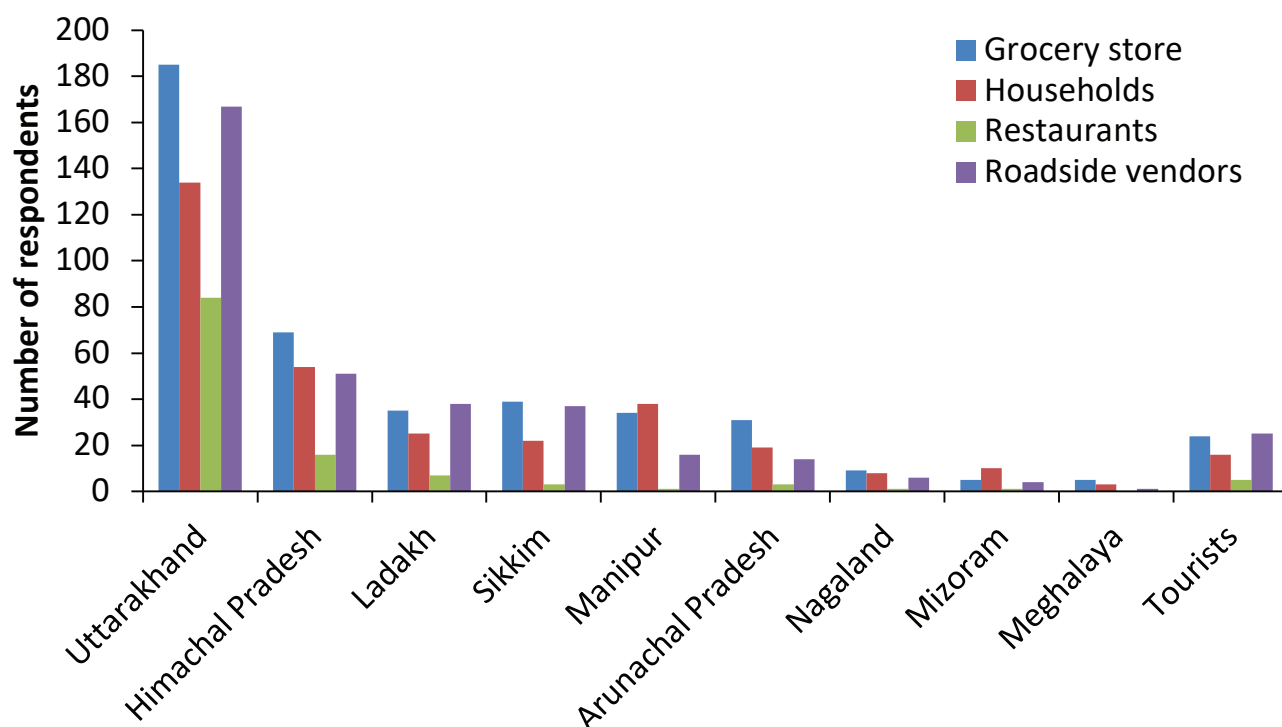


Figure 5.2. Major sources of plastic waste as per the perception of the respondents in the questionnaire survey.

Plastic recycling is an the appropriate and easily realized action which immensely helps in reduction of plastic pollution. Among the respondents, nearly 24% practices consistent plastic recycling at their homes, whereas 53% practice recycling occasionally and 23% do not practice recycling at their house (Fig. 5.4, Q5). Similarly, 48% respondents always use reusable bags for purchase of groceries whereas 47% use occasionally and 5% do not use such bags (Fig. 5.4, Q6). When asked if you take active efforts to reduce your consumption of single use plastic, nearly 46% replied in positive whereas 48% replied that they take active efforts occasionally whereas 6% replied they do not take any such efforts (Fig. 5.4, Q7). Nearly 80% of the respondents are already aware about the ecofriendly alternatives of the single use plastic and have used such products whereas 20% of the respondents are unaware about the plastic alternatives (Fig. 5.3. Q8). Further, nearly 64% of the respondents have promoted the elimination of SUPs and raised their voice against the use of plastic products (Fig. 5.3. Q9).

Willingness to pay has been highlighted as a major driver for adoption of eco-friendly plastic alternatives. Among the respondents, 58% are willing to pay higher prices for switching the plastics to eco-friendly alternative products provided they are readily available in the markets and are durable for use, whereas 30% expressed their occasional

willingness and 12% did not showed their willing to pay higher prices for alternatives (Fig. 5.4, Q10). Similarly, 92.5% of the respondents claimed that they are aware about the impacts of plastic waste on environment and pollution caused by the plastics (Fig. 5.3, Q11). When asked about their awareness on the regulations related to the reduction of plastic waste and SUPs, 64% responded in positive whereas remaining were unaware about such regulations and policies (Fig. 5.3, Q12). When asked about their contribution towards elimination of SUPs, 90% respondents claimed their significant roles in reduction of plastic waste and SUPs (Fig. 5.3, Q13). Finally, only 34% of the respondents expressed that the existing efforts of the state government are sufficient to tackle plastic pollution whereas 66% believed that more intensive efforts and stringent regulations are required to tackle the problem of plastic waste and SUPs (Fig. 5.3, Q14).

In summary, a large sample of respondents (1245 people) revealed that behavior of the Himalayan communities has been changed significantly by Prime Minister's appeal for elimination of plastic pollution and SUPs. Nearly 75% of the respondents including farmers, shopkeepers, students, service men and tourists acknowledged that Mann ki Baat has impacted their behavior for refusal or recycling of plastic and 96% of these also claimed that they have participated in the cleanliness campaigns for elimination

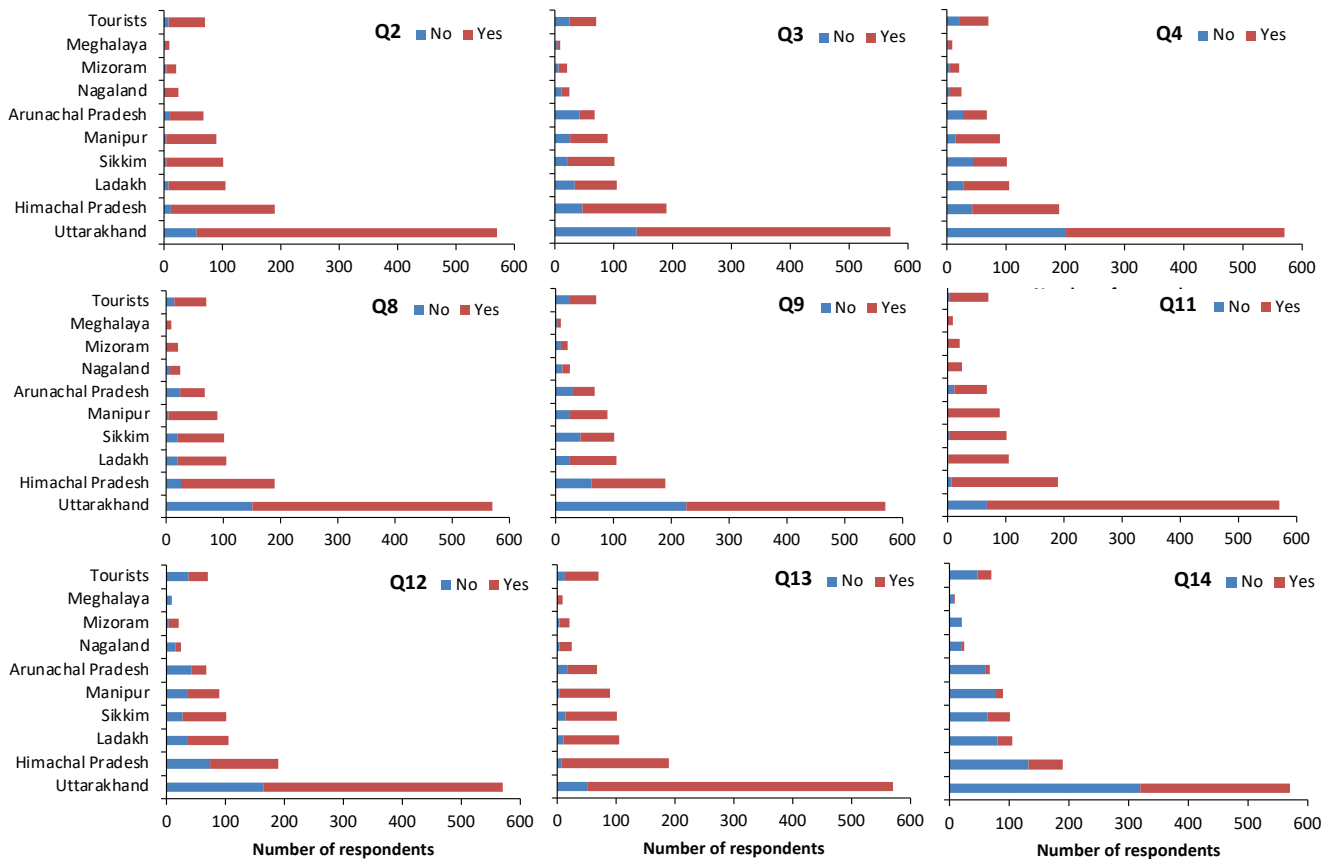


Figure 5.3. Response of the respondents on question Q2-Q4, Q8-Q9, Q11-Q14 in the table 5.1, related to the plastic pollution and single use plastic asked during the questionnaire survey in the Indian Himalaya.

of plastic waste in the Himalaya. Many people are doing consistent plastic recycling at their houses and nearly 80% are aware and have used ecofriendly alternatives of plastics available in the markets. A large percentage of people (87%) are willing to pay higher prices for the eco-friendly alternative products for elimination of plastic waste to reduce environmental impacts. However, comparatively small portion (34%) of the people believed that the current efforts of state governments are sufficient whereas a large percentage believed that more stringent regulations and intensive monitoring of violators for use of SUPs is needed to tackle the prevailing problem of plastic pollution in the Himalayan region.

5.2. Focal Group Discussions

Seeking about the impact of government's consistent efforts towards the plastic waste management, focal group discussions were conducted to understand the people's perceptions about such initiatives. The qualitative data was collected using Focus group discussion method (statements were documented through hand-written notes and video recording) and one-to-one interview through questionnaire survey (Table 5.2). The participants

represented different groups like people from rural areas, urban areas, academic institutions in Himachal Pradesh and Uttarakhand. Tourists visiting these regions and representing states such as Bihar, Maharashtra, West Bengal, Orisha, Goa, Harayan etc were also included in the FGD's.



Depiction of Focal Group Discussion with rag-pickers of Kullu, Himachal Pradesh

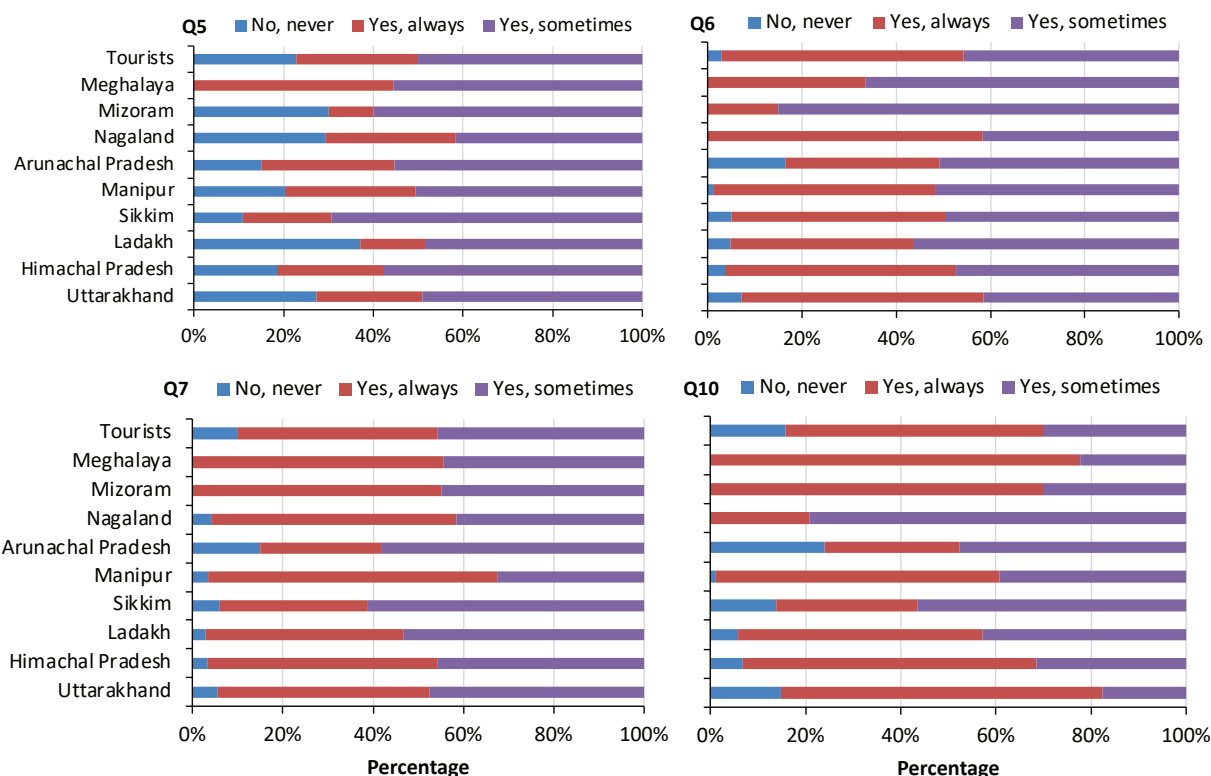


Figure 5.4. Percentage of responses obtained during the questionnaire survey for questions Q5-Q7 and Q10 in the table 5.1. designed for questionnaire survey in the Himalayan region.

Table 5.2. Questions/topics discussed during Focus Group Discussions (FGD's)

S. No.	Topic/question
Q1	Collection of plastic material- market, quantity, long-term use, or short-term use, type of plastic material, etc
Q2	Disposal and managing of plastic waste- collection of waste through the municipality, frequent collection of waste, any traditional techniques for disposal and management.
Q3	Plastic pollution and its impact- Plastic pollution impacts, health, issues/hazards, impact on animals, environment etc.

A detailed discussion was held with the Executive Officer of the Manali, Kullu and Bhunter in Himachal Pradesh regarding elimination of SUPs. It was informed that the municipal council has observed a 10-20% decreased in the SUPs. To impose challans, 25 authorised officials have been nominated. Approximately 34 Challans have been imposed and amount of Rs. 35,000/- have been generated by Municipal Council, Kullu after the SUP Ban in July 2022. Detailed instruction and awareness guidelines have been circulated among public. During a Focus Group Discussion (FGD) with Ragpicker it was observed that most of the rag-pickers were between 30–50 years of

age and were uneducated. Ragpickers revealed that they have witness a substantial reduction in plastic waste during last six months, thus very small amount of plastic waste is being collected by them. During discussion with Himachal Pradesh Pollution Control Board information on only ten authorised recyclers was obtained for the whole state, whereas three manufacturers were found who manufacture biodegradable alternative of SUP bags.

Further, in the markets of Kullu & Bhuntar a total of 35 shopkeepers and whole sellers were questioned on the single use of plastic. It was observed from the survey

with biodegradable compostable material, such as plastic spoon to wooden spoon, plastic carry bags to biodegradable compostable polymer bags, cloths bags and paper pouches, plastic juice straw to paper straw, polythene milk packet to carton milk packet (cardboard material), plastic ropes with jute ropes. The cost difference between plastic materials and the biodegradable material is huge e.g. approximate rate of plastic spoon per packet was Rupees 30/- whereas, wooden spoon per packet price is Rupees 70/-. It has also been observed that they have to pay higher amount of tax on the biodegradable materials. Plastic still hasn't been replaced fully in shops and markets as discussed with shopkeepers because they only can find the alternative which depends on their income. Therefore, the main reason of the shopkeepers and whole sellers to avoid buying biodegradable products is that it is more expensive compared to plastic products. If the biodegradable materials cost cheaper than the plastic products the shopkeepers will definitely buy them. Plastic cannot be fully replaced as the shopkeepers do not have the control on manufacturing products. They pointed out that packaging material of products such as Maggie, chips wrappers etc. should be replaced from the manufacturing industries.

Similarly, in Srinagar Uttarakhand, a FDG was held with a total of 20 respondents (distributors/sub distributors & shopkeepers) representing grocery general store, medical store and fruit & vegetable sellers. Among the respondents, 12 persons claimed that after the single-use plastic Ban the use of SUP has now decreased by 76-100% whereas 3 respondents believed a reduction of 50% and the remaining believed that the reduction is less than 50%. Twenty five percent shopkeeper had stopped using or selling SUP in the last 7-12 months whereas 60% had stopped selling or using it in the past 2-6 months, while 15% are still selling or using it along with other types of carry bags. The alternative options for replacing SUP bags are biodegradable bag, newspaper envelop and cotton bags. The majority of respondent suggested that SUP bags were more durable, stronger and cheaper (Rs 0.20/bag) than the new alternative biodegradable bags (Rs. 2/bag). Despite this, at present over 50 % vendors and shopkeepers are using biodegradable bags and discarding the use of SUP.

Another FDG was also conducted with 26 respondents (tourist and shopkeepers) at Kasar Devi and Chitai Temples cum tourist places of Almora, Uttarakhand.



Some alternatives of plastic products available in the markets of the Himalayan towns.

Among them 10 tourists and 7 shopkeepers have appreciated the government initiative on door-to-door collection and separation of garbage during last 6 months. All the respondents (100%) from tourists' groups were well aware about the ill effects of plastic pollution on environment. All of them were ready to pay even more amount for biodegradable alternatives instead of polyethylene bags, disposable utensils, packaging material and carry bags. They have also shown their concern about the production of biodegradable packaging material for liquid products such as milk, curd, oil water etc as well. The shopkeepers are willingly paying the monthly charges of Rs. 40 for collection of waste from shops. More than 50% shopkeepers have stopped using SUP and replaced packaging material with paper bags, news paper bags and biodegradable bags during last six month.

Good practices and success stories

Plastics have become pervasive in our daily lives, with its production steadily increasing over the decades. With the increasing production of the plastic waste its detrimental effects on the environment and human health are becoming more apparent. The growing awareness on the environmental impacts of the plastics industry has thus led to a greater demand for adoption of circular systems within the industry. In a circular system, materials ideally retain their original quality. If recycled they can be recovered into the same type of products resulting in reduction of raw material which are obtained from natural resources thus reducing emissions and waste. Several circularity strategies exist to prevent resource extraction and primary material demand as well as waste production. Currently, the circular systems are being seen as a logical alternative to the existing linear economy models involved in the industry of plastic products. While in a linear economy, natural resources used in manufacturing of products are incinerated or landfilled, the essence of a circular economy is to preserve such resources by retaining quality and value of the used materials.

Different R frameworks have been proposed to develop circular systems for usage of the plastic products. 9Rs is considered as the most comprehensive framework which uses 10 different actions during different stages of the economic cycle of a product. In this framework, the first three R's i.e., R0 to R2 are focused on smarter product use and manufacture, R3 to R7 involves extending the lifespan of product and its parts whereas R8 and R9 includes useful application of the materials. Key strategies to achieve the 9 R's for promoting the circular systems in plastic industry includes innovations in core technology, innovations in product design, innovations in revenue model and socio- institutional change. Many of these activities and actions have already been adopted by the manufacturers, distributors, consumers, administration, and other stakeholders in India including in the Indian Himalayan regions. However, a comprehensive documentation of good practices which are essentially promoting the circular strategy in plastic management in the Himalayan Region is not available. We conducted a compressive survey and review of online resources to document notable good practices for development of circular economy of the plastic products in the Himalayan region. The good practices have been categorized under three groups i.e., Smarter product use and manufacture, Extend lifespan of product and its parts, Useful application of materials.

6.1. Smarter product use and manufacture

The first three R's of the 9R framework are considered under this category as these actions involve reduction or efficient use of the material to minimize waste generation in using plastic products. The first action i.e., R0: Refuse targets on making the plastic product redundant by abandoning its function or by offering the same function with a radically different product. Similarly, R1: Rethink reduces the waste generation by intensive use of the products through various practices such as sharing products, putting multi-functional products in the market etc. R2: Reduce acts on increasing the efficiency in product manufacture or use by consuming fewer natural resources and materials. Thus, all the three R's essentially helps in reduction of the plastic waste through behavioral and technological intervention during different stages of the plastic life cycle. Across the Indian Himalayan region, various example of the smart product use and manufacture are available some of which have been mentioned here.

Complete Ban on Single Use Plastic

Sikkim is the first Indian state to ban disposable plastic bags and single-use plastic bottles in 1998 due to a massive rainstorm in 1990s. Huge amount of plastic carry bags were washed down to the rivers with landslide and resulted in casualties. Thereafter, the state government decided to ban plastic bags. The initiative involved an intensive daily garbage collection by the municipal staff which recycled 20-30 percent of the waste. Later other organizations like ECOSS and WWF, Swachh Bharat Campaign collectively aimed for the zero waste Himalayan project. Other plastic alternatives such as non-woven polypropylene bags are also introduced to tackle plastic waste. Additional penalties and mass awareness program were also introduced alongside plastic alternatives to effectively manage plastic waste problem in the state. A survey conducted in 2014 and 2018 by ToxicsLink and eCoexist, stated that Sikkim has performed well in the implementation of green policies and successful management of plastic waste.

Similarly, in Ladakh region of erstwhile Jammu & Kashmir state, Women's Alliance of Ladakh worked towards making Ladakh free of plastic carry bags in the 2018. With increasing tourism, the region was facing enormous pressure of plastic waste and sewage on daily basis. The government of erstwhile state of Jammu and Kashmir along with Women's Alliance of Ladakh banned plastic bags and a penalty of Rs. 5,000 or up to one month in jail or both was implemented. The volunteers inspect shops and

markets and keeps a check on plastic bags use. Handmade cloth bags were also provided to the shopkeepers which helped in income generation of the local communities while promoting the environmental sustainability in Ladakh.

Plastic alternatives from Pine needles

Chir Pine forests of the western Himalaya are vulnerable to forest fires, as the dry leaves of pine trees are highly inflammable due to its resin content. Thus, G.B. Pant National Institute of Himalayan Environment developed an economically viable use of pine leaves by developing



File covers and folders manufactured from Chir Pine needles as alternatives to plastic products



technique to manufacture alternatives of plastic products like carry bags, file covers, folders, etc. National Handmade Institute, Jaipur have tested the composition and properties of the products in 2019. The paper obtained is environment friendly and rapidly bio-degradable. Further research is under progress to make the product more water resistant and production of unbleached craft paper, filler, packing cases, paper board etc, which can replace a wider array of plastic products while reducing the forest fires in the western Himalaya. The technology and products are being promoted through the Rural Technology Centres of the institute at Almora, Uttarakhand and Kullu, Himachal Pradesh. To create complete supply chain of these commercially viable products, linkages are being developed with paper and handicraft industry,

MSMEs, State Industry Department, forest Development Corporation, Rural Development programs, etc.

Bamboo for Plastic

The state government of Tripura has launched a project called “Bamboo for Plastic,” which aims to replace single-use plastics with eco-friendly bamboo products. Under this initiative, bamboo is used to make products like straws, plates, and cups, an alternative to SUP products. The project reduces the use of SUPs and provides employment opportunities to the local people. The initiative has received positive feedback from the local community and has encouraged the government to expand the project to other parts of the state.

Bamboo Water bottles

Lachen, a small town in Sikkim, located at 2,750 meters, officially banned the use of all plastic water bottles in 2011 and followed that by banning all plastic carry bags in 2018. It attracts ~100,000 tourists every year. To stop the plastic pollution in the region, the locals led the initiative to ban plastic. This is one of the most successful plastic bans due to the locals. Now, if tourist carrying plastic bottles, the driver accompanying them, usually a local, is fined. A penalty of Rs 500 is imposed to the first time offender, followed with Rs 1000 and Rs 2000 for the second and third time offender and is increased to higher amounts repeat offenders. In order to provide an alternative for the



Bamboo water bottles introduced for the tourists by Lachen village in Sikkim

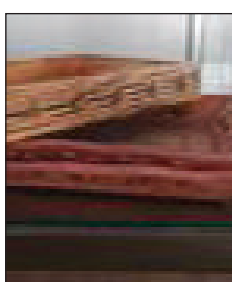


plastic bottles, people in Lachen have introduced bamboo water bottle. Tourists visiting Lachen purchase bamboo water bottles which have become an attraction as a local souvenir and are getting promoted across the country as gift items and message for eco-friendly alternative to the plastic products.

Plastic free Rajniwas

In order to promote the plastic free campaign, the Government of newly formed Ladakh UT in 2020 started an initiative to develop a plastic free Rajniwas i.e., the Lieutenant Governor's office. The task was assigned to the Ladakh Regional Centre of G.B. Pant National Institute of Himalayan Environment and a short term project was undertaken to replace all plastic based products with eco-friendly products in the top office of the UT. A summary of activities for replacing the plastic with other products is provided below:

Plastic items	Replaced by
Plastic water mineral bottles	Copper and steel bottles, RO water purifiers
Plastic pen	Tree less pen (made by recycled paper)
Plastic pencil box	Tree less box (made by recycled paper)
Plastic trays	Wooden trays (made by eucalyptus)
Plastic dustbins	Tree less dustbins (made by leaf and stem)
Plastic flower pots	Earthen flower pots
Tree based product	Replaced by
Office file covers	Tree less file covers (Made by pine needles)
Pencil/colour pencil	Tree less (Made by recycled paper)



Some items replaced for plastic products in the Rajniwas of Ladakh UT.

Give Plastic and Take Gold

In Anantnag district of Kashmir, Farooq A. Ganai who is a lawyer by profession and sarpanch (head) of the village, initiated a unique campaign 'Give Plastic and Take Gold' where people of the village are asked to collect 200 kg of plastic waste and get a gold coin from the Panchayat head. The campaign became very popular and within two weeks after its launch Deputy Commissioner of the region declared the village as plastic-free in January 2023. The village has been portrayed as an example for other villages of the UT as all villagers took part in the drive and now it is the first plastic free village in the Kashmir valley.

Plastic based vertical gardens

In Jammu city, Nazia Rasool has established an unique example of plastic waste management by planting vertical gardens using old plastic bottles as pots. The idea is both cost-effective and creative, as it reduces the littering of plastic waste and ensures minimum wastage of water during irrigation of the garden plants. Such models have currently been built at Government College for Women in Gandhi Nagar and Police Public School, Jammu.

6.2. Extend lifespan of product and its parts

A major strategy in developing a circular system include extending the lifespan of the plastic products and their parts. Among the 9R's for circular systems five R's i.e., R4-R7 can be included in this category of actions which mainly focuses on reuse, repair, restore or remanufacturing of the plastic products. R3: Reuse involves reusing a plastic product with another consumer of discarded product which is still in good condition and fulfils its original function. R4: Repair acts on repairing and maintenance of defective product so it can be used with its original function. R5: Refurbish helps in restoring an old product and bring it up to date. R6: Remanufacture emphasizes on using parts of discarded product in a new product with the same function and R7: Repurpose uses discarded product or its parts in a new product with a different function. All these actions ultimately help in reduction of the plastic waste through extending the lifecycle of the plastic products and their parts. Some good practices in the Himalayan region which focuses on these actions are as below.

QR Code based collection

In Rudraprayag district of Uttarakhand, a Hyderabad-based cleantech company initiated a unique campaign wherein a QR code enabled deposit refund system (DRS) was developed to collect and recycle plastic bottles during the Kedarnath yatra. In order to collect the waste plastic bottles, QR codes were placed at an extra cost of Rs 10,

which were later refunded to the pilgrims on return of the bottles. The programme was initiated in Rudraprayag and was later launched on a larger scale from Guptkashi to Gaurikund (a 55-km stretch). The bottles were collected at 733 shops and 12 designated centres and the waste was sent to a recycler in Kashipur. Through the DRS system, nearly one lakh QR codes were sold and 35,000 plastic bottles were recycled that would have otherwise ended up in local water bodies and down mountain slopes. The initiative also generated new jobs and an additional income source for the local community. The initiative own 'Digital India' award under the category of 'digital initiatives in collaboration with start-ups' in January, 2023. Keeping in view the success in Rudraprayag district, the Uttarakhand government has planned to implement the QR based plastic waste collection system in the entire route of Char Dham Yatra in the year 2023. This unique initiative encourages tourists and pilgrims to be responsible for their waste and contribute towards maintaining the pristine beauty of the Himalaya. The QR-code-based system is a step towards creating a circular economy, as the waste collected can be effectively processed and recycled. Up to 45 lakh QR codes are expected to be printed this year, indicating the scale and impact of the initiative. This system also creates employment opportunities for local waste workers, who will process and manage the collected waste. The implementation of this waste-disposal system is a significant step towards promoting sustainable tourism in Uttarakhand.

Waste to Fuel

A Dehradun based NGO, Indian Pollution Control Association (IPCA), has been working for a long time towards plastic waste management in Uttarakhand. During past three years particularly after July 2022, IPCA has recycled an astounding volume of 6,772 million tonnes of plastic waste. Dehradun produces around 327.9 tonnes of plastic waste every day which is expected to reach nearly 600 tonnes under the current scenario of increasing urbanization and tourist activities. IPCA's efforts are focused on counteracting this future plastic waste estimate. By educating and training waste workers, IPCA collaborates with urban local bodies to improve source segregation, which has increased the efficiency of recycling. The waste workers can now distinguish between various types of plastic, leading to better sorting and processing of plastic waste. The success of IPCA's initiatives in Uttarakhand is a testament to the effectiveness of community-driven efforts towards sustainable development. Their work serves as an inspiration to other organizations and individuals to take action towards plastic waste management, protecting the environment and promoting a circular economy.

Waste Warriors initiatives

Waste Warriors (WW) is a non-profit organization catalysing systemic change to solve the waste management crisis in the Indian Himalayan region. With a team of 160+ Warriors spread across various locations nestled in the beautiful landscapes of Uttarakhand and Himachal Pradesh, WW strive to enable access to effective waste management services in urban and rural areas, with a special focus on eco-sensitive and tourist areas. By promoting local entrepreneurship, WW aim to ignite agency in women and youth to earn their identity through dignified livelihoods. Currently, WW has active interventions across nine locations in the Himalayan region including urban landscape of Dehradun, Dharamshala, Muni ki Reti (Tehri Garhwal), rural landscape of Bir-Billing, Kempty (Mussoorie), Kasauli and eco-sensitive and biodiversity zones in Jim Corbett tiger reserve, Renuka wildlife sanctuary and Govind wildlife sanctuary.

During the year 2021-22, WW trained 27,000 people in door to door engagement, in house workshops and online sessions, processed 760 Mt of dry waste collected from 2 facilities and engaged 390 waste workers in this task. The Model Ward Program of WW in Dharamshala includes community engagement & activation, waste awareness & segregation interventions, facilitating municipal collection systems, promoting responsible disposal and composting, and training on best SWM practices. The engaged groups include residents, commercial establishments, tourists, tourism businesses, transport operators, students, school administration, municipal staff and waste workers. Similarly, in their Model Jail Program which is being implemented under the name 'Waste Under Arrest' at Lala Lajpat Rai district Correctional home in Dharamshala, various action are being taken like infrastructural support, IEC posters, training of workers, staff, and inmates on segregation and the right disposal of waste that is generated in the premises.

Healing Himalaya Campaign

In Himachal Pradesh, an intrepid traveller Mr Pradeep Sangwan after witnessing the plastic waste littering in the mountains, initiated a campaign "Healing Himalayas" in 2016. He along with his team and thousands of volunteers have conducted hundreds of clean up campaigns to collect the plastic waste for its recycling and recovery. To handle the collected waste through various clean up campaigns in multiple panchayats they have built 5 material recovery facilities at locations with substantial tourist footfall where nearly 4-5 tonnes of non-biodegradable waste is collected daily. The initiative had set an unique example which was mentioned in "Mann ki Baat" in December 2020 and is

motivating people for plastic waste elimination in other parts of the Himalaya.

Buy-Back Initiative

Government of Himachal Pradesh has decided to buy non-recyclable and SUP waste @ Rs. 75/kg through registered rag pickers and individual households in state of HP. For this purpose a Buy Back Policy has been notified on 1st October, 2019 and this Policy has been formally launched by the Hon'ble Chief Minister on 2nd October, 2019. All type of packaging plastic waste of items such as bread, cakes, biscuit, cookies, namkeen, chips, wafers, candies, mattresses, cheese puffs, ice cream, ice cream candies, noodles, cereals, cornflakes, breakfast cereals coated with sugar, confectionary items. Cleaned and dry packaging, pouches/packets of liquids such as milk, oil, shampoo, hand wash, liquid soap, curd, butter milk, juice etc. are eligible for the buyback campaign. The initiative has been started to reduce the plastic waste littering and promote the recycling of the plastic material for its recovery or remanufacturing.

Community cleanliness drive

Trekking and expedition as part of adventure tourism are popular among national and international tourists visiting Ladakh. These activities involve large number of tourists visiting the pristine Himalayan ecosystems for recreational purposes, and generate waste in the form of plastic, tin, glass, paper, etc. In Ladakh during July 2020, prominent government and non-government organizations joined hand to organize a weeklong cleanliness drive on the famous Markha trekking route which every year invites nearly 6000 trekkers. Prominent organization participating in the drive include All Ladakh Tour Operators Association, Ladakh Women's Travel Company, Tourism Department, Leh and G.B. Pant National Institute of Himalayan Environment. The major goal of the drive was to quantify the solid waste accumulated along the trek, and appropriately dispose at a recycling unit. A total of 837.4 kg of waste was collected in 8 days of trek, comprising tin (44%), plastic waste (30%) and glass (26%). The plastic waste included bottles, containers, broken crates, tetra packs, plastic wrappers, cardboard, bottle caps etc. All collected waste was handed over to Solid Waste Resource Management Centre, Choglamsar, Leh for further processing and recycling.

Bring Plastic, Earn Money

In Itanagar, Arunachal Pradesh a campaign "Plastic Lao, Paise Kamao" (Bring Plastic, Earn Money) has been initiated to encourages people for plastic waste collection and its exchange for money at designated collection points. The program has successfully reduced plastic waste in the

city and generated income for waste collectors. Similarly, in the Tawang district local community has initiated a plastic waste management program called "Clean and Green Tawang." This program involves collecting plastic waste and sending it to a recycling facility outside the state. The program has successfully reduced plastic waste in the area and generate employment opportunities for local people. In Changlang district, Mr. Rajiv K. Singh, has started a plastic recycling unit to convert plastic waste into useful products like chairs, tables, and buckets. Singh's unit has provided employment opportunities to many locals and helps clean up the environment by reducing plastic waste. The project highlights the benefits of recycling plastic waste and how it can become a profitable business while being socially and environmentally responsible.

Earning from plastic waste

Understanding the importance of waste management a Women Self Help Group at SechuZubza, Nagaland, made cleaning up their job and also as a beneficial activity. Member of the Women SHG who are farmers, housewives and small business owners got motivated from scrap collectors and started doing the job by themselves to keep their environment clean and safe. Groups of 2-3 members were created to collect waste along the National Highway-29 which passes through the village and river located within their jurisdiction, and also collect pet bottles etc, from small streams of the town, which was in abundance at the beginning. They collect waste including plastic bottles, tins, metal waste, paper waste, tires, etc. The collected waste is then segregated and transported to Dimapur for its sale to scrap dealers.

Similarly, village Merangkong in Nagaland has initiated a plastic waste management program called "Clean Merangkong." This program involves collecting plastic waste and sending it to a recycling facility outside the state. The program has successfully reduced plastic waste in the area and generate income for waste collectors. Another example is the "Eco Club" program in schools in Nagaland. This program encourages students to learn about environmental issues, including plastic waste, and take action to reduce waste in their communities. The program has successfully raised awareness and promoted student behaviour change.

Waste to wealth initiative

Local communities and NGOs in Tripura has started an initiative to reduce plastic waste and promote recycling. For example, Tripura's "Waste to Wealth" initiative aims to convert plastic waste into usable products such as paver blocks and flower pots. The program involves collecting

plastic waste and sending it to a recycling facility where it is converted into these products. The program has successfully reduced plastic waste in the area and generated income for waste collectors. Another example is the “Clean Agartala” program, which involves collecting and sending plastic waste to a recycling facility outside the state. The program has successfully reduced plastic waste in the city and promoted public awareness of proper waste management importance.

Green Mizoram

A group of women in Mizoram are striving towards eco-friendly plastic alternatives by making eco-friendly products like bamboo straws, paper bags, and cloth bags etc. The organization provides training and support to women to improve their skills and promote entrepreneurship. The initiative has successfully promoted sustainable practices and provided women with employment opportunities. Similarly, “Mizoram Plastic Waste Management Project” is a joint initiative of the state government and the United Nations Development Programme (UNDP) to promote sustainable waste management practices, including plastic waste recycling. The project involves setting up of recycling facilities in various locations across the state, training waste collectors and promoting public awareness about the importance of proper waste management. Another example is the “Green Mizoram” initiative, which aims to promote sustainable development and environmental conservation in the state. The initiative includes various programs to reduce plastic waste through cleaning of public spaces, promoting proper waste disposal, and promoting recycling of plastic waste into usable products such as bags and handicrafts.

Plastic Free Manipur

The “Plastic Free Manipur” initiative is a grassroots movement aimed at reducing plastic waste in the state. The initiative involves organizing clean-up drives, promoting public awareness about the harmful effects of plastic waste, and encouraging the use of eco-friendly alternatives to plastic. Another example is the “Waste Warriors Manipur” initiative, which involves setting up recycling facilities in various locations across the state and promoting the recycling of plastic waste. The initiative also involves training waste collectors and promoting public awareness about the importance of proper waste management. Other examples include “Eco-friendliness Awareness Campaign” by the Manipur Pollution Control Board to promote eco-friendly alternatives to plastic through capacity building and distribution of cloth bags, “Clean Imphal Campaign” for door-to-door collection by the Imphal Municipal Corporation and “Green Manipur Mission” by the

Department of Environment to reduce plastic waste by promoting use of cloth bags and eco-friendly packaging, and setting up recycling facilities.

To recycle plastic waste, another campaign has been started in Imphal for collection and segregation of plastic waste from households and commercial establishments, followed by recycling into products like bags, ropes, and mats. The recycled products are then sold at affordable prices to promote their use as an alternative to SUP products. The initiative has provided employment opportunities for women and has contributed to the reduction of plastic waste in the city. Similarly, a 58-year-old man from Manipur is using plastic waste to make brooms as an alternative to traditional brooms made from natural fibres. The man collects plastic waste from his neighbourhood and converts it into brooms using a simple hand-operated machine. The brooms made from plastic waste are more durable and long-lasting than traditional brooms and are sold at an affordable price.

Eco-Friendly Bags

The Khasi Hills Autonomous District Council has launched “Eco-Friendly Bags” campaign to promote the use of eco-friendly bags in the state. The initiative involves distributing cloth bags to households and promoting the use of these bags instead of SUP bags. This has helped to reduce the amount of plastic waste generated in the state and promote sustainable living practices. Similarly, “Clean and Green Shillong” campaign initiated by the Meghalaya Police is setting up waste segregation centres in various locations across the city, conducting clean-up drives, and promoting public awareness about the importance of proper waste management. The initiative has helped to reduce the amount of plastic waste in the city and promote a cleaner and greener environment.

6.3. Useful application of materials

In the circular systems of plastic life cycle, an increasing emphasis on re-utilization of the material in production is being given by the environmentalist, economists, and policy makers. The recycling of same product while retaining the grade of the material or recovery of the waste material to develop new product or energy will reduce the impact of the production industry on consumption of raw material and thus saving both natural resources as well as energy usage. Two R's i.e., Recycle and Recover are included in this action where R8: Recycle involves processing of the materials to obtain the same (high grade) or lower (low grade) quality and R9: Recover focuses on incineration of materials to recover the energy. The useful application of plastic material at the end of its first life cycle in developing

a new material or recovering energy provides an excellent option to reduce the burden on natural resources on earth which are becoming scarce due to increasing human population and industrialization. Some of the examples in the Himalayan region for useful application of the plastic waste material are as under:

From plastics to diesel

Plastic can be converted into petrol, diesel and other hydrocarbons. CSIR-Indian Institute of Chemical Technology (IICT), Hyderabad has developed a catalyst that can be used for conversion of waste plastics to fuel oils. CSIR-Indian Institute of Petroleum (IIP), Dehradun in collaboration with GAIL (India) Ltd. has developed a process by which waste polyethylene and polypropylene type plastics can be converted into petrol and diesel. One kilogram of waste polyethylene and polypropylene can be converted to either about 600-650 ml of petrol or 700-750 ml of diesel along with LPG. The technology is unique in terms of its exclusive production of either gasoline or diesel which meet the BS IV/VI specifications and emission norms and plants can be set up to capacities of 1-10 TPD. Presently, CSIR-IIP and GAIL India had set up a pilot /demo unit of 1 ton per day capacity at CSI-IIP, Dehradun. Further, to promote the technology at industrial scale, CSIR-IIP had signed an MOU with Delhi Development Authority (DDA) for implementing the developed model.

The first government plastic waste to fuel plant was officially opened in August 2019 at Dehradun, Uttarakhand. The facility has the ability to turn 1,000 kg of plastic waste into 700 to 800 litres of BS-VI quality diesel. As IIP's social technology partner for the Plastic Waste to Fuel project, the Social Development for Communities (SDC) Foundation is currently connected to the organisation. Plastic Banks have been installed all over the city of Dehradun in several locations, including schools, car dealerships, hospitals, government buildings, and hotels for collection of the plastic. Establishing a supply chain for plastic waste and facilitating community-driven source segregation are the two main purposes of the Plastic Banks.

In Tripura, Dipak Paul, has developed a method to recycle SUP waste into fuel for locomotives. He uses a machine to convert plastic waste into fuel, which can be used as an alternative to diesel. This method not only helps to reduce plastic waste but also provides an affordable and eco-friendly solution for fuel. Dipak Paul has received recognition and support from the Indian Railways and various other organizations for his innovative solution to address plastic waste and fuel scarcity.

From plastic to Graphene nanosheets

Kumaun University, Nainital, Uttarakhand has taken a significant step towards sustainability by implementing a low-effort and eco-friendly upcycling route for plastic waste under the National Mission of Himalayan Studies (NMHS) project. A two-stage pyrolysis process has been developed that can convert plastic waste into graphene nanosheets (GNs) on a large scale. The GNs synthesized through this process have been studied for their super capacitive behaviour, and the results have been impressive. Design and establishment of Plastic up-cycling machine SWAYAMBHU WRM- 2021 has been accomplished for conversion of plastic waste into graphene and high calorie fuel (14000 k cal/kg). The technology provides a sustainable and cost-effective option for propelling a circular economy through waste plastic upcycling. It also opens up the possibilities for energy storage applications using GNs synthesized from plastic waste, contributing to the development of clean energy technologies. The technology is thus a breakthrough to eliminate SUP caused problems by synthesizing carbon nano-materials such as Graphene, carbon nano- tubes, high value-added fuel and additives for the concrete mixture. Besides generating high value graphene, the synthesised products can also help in supplementing the supply of fossil fuels, and reducing cement consumption in construction activities. National Research Development Corporation (NRDC), an enterprise under the Department of Scientific and Industrial Research, Ministry of Science and Technology, has signed a MoU for transfer of this technology. If upscaled at a wider industrial scale, the technology has a big scope for implementing sustainable solutions to environmental challenges.

Building roads with plastic waste

The Border Roads Organization (BRO), which builds and maintains the strategic roads, has constructed roads connecting mountain areas through use of plastic waste. Six roads in border states viz. Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh, and Mizoram passing through difficult mountainous terrain and inclement weather conditions were identified for the trial. The BRO has used the technology in restoring more than 13 km of border roads. It included 4.5-km on Phuentsholing-Thimphu Road in Bhutan, 2.5 km on Balipara-Charduar-Tawang road and 1 km on Roing-Koronu-Paya road in Arunachal Pradesh. Plastic has also been used to resurface 5.2 km on Hnathial-Sangau-Saiha Road in Mizoram and 2-km on Hapoli-Sarli-Huri Road in Arunachal Pradesh. The top layer of road surface is constructed with bituminous concrete blended with certain percentage of shredded waste plastic material as

pilot study. Plastic waste is collected and shredded before it is mixed with aggregates and bitumen at the design temperature. The resultant material is then used for black topping of the road surface as a wearing course. The use of plastic prevents seepage of water or moisture in the surface and assists in close binding of aggregates resulting in a smooth and durable surface with a longer life span.

The environmentally friendly approach of the plastic road was also experimented by the Nagaland Pollution Control Board (NPCB) at its office premises. The technology was later replicated by an NGO, Living for Environment (LiFE) in partnership with Dimapur Municipal Council (DMC) at Duncan Basti, Dimapur. Considering the growing problems of plastic litter in the state and poor road conditions, LIFE's first plastic road project was to blacktop a portion of the Dimapur Municipal' Council office compound. Tripura State government has also constructed its first-ever road using non-recyclable plastic waste. The road construction project involved mixing shredded plastic waste with bitumen to create a polymerized bitumen mix to lay the road surface. The plastic waste used in this project was collected from households, municipal corporations, and other sources, which would otherwise have been dumped in landfills or littered on the streets. Similarly, Meghalaya state government also launched a

project to collect SUP waste and convert it into polymer-modified bitumen for use in road construction. The government plans to expand the project to other areas of the state and has received positive feedback from local communities and environmental groups.

Plastic based products

In Manali, Himachal Pradesh a Hotelier Mrs. Kalpana Thakur has started manufacturing popular products like beautiful earrings, bangles, bags, flowerpots, brush & pate holders, jewellery box etc using the plastic waste like bottles, polythene bags etc. She initiated this task after Naggar Panchayat of Kullu district started imposing ban on the use of plastic bags 1995 to 1997. In the times, when there was no access to internet, social media she did not had any knowledge on the effects of plastics. Slowly, she started to understand the long term effects of the plastic and its harm to the environment. After understanding the consequences and bad effects of the plastics she started working on it. Today as an entrepreneur she is running hotel near Manali which is totally plastic free and earning Rs. 5000 to 12000/- month through sale of recycled items according to the footfall of tourists. Her work was appreciated through many awards from the government and welfare organisations.



Some decoration and jewelry products manufactured from the plastic waste by an entrepreneur in Himachal Pradesh

Conclusion and recommendations

Although Himalayan region has witnessed remarkable changes towards reduction of plastic waste during past five years, but elimination of single use plastic will end the plastic pollution completely. Prime Minister's appeal for curbing plastic pollution in Mann ki Baat has increased consciousness of the Himalayan communities towards plastic cleanliness, recycling, and adoption of alternative products. Waste management facilities have also improved in the region and necessary regulatory actions as per the provision of the Plastic Waste management Rules, 2016, amended in 2021 and 2022, have been taken in different states and UTs across the Himalaya. Research and development activities have provided scientific insights for new technologies to develop alternatives, useful products and to use plastic waste for energy production. Many good practices for plastic waste reduction, recycling and removal have been documented which are drivers of a real change at the grass root level across the Himalaya. However, it was perceived that the existing efforts of the state governments are insufficient for curbing the plastic pollution. Stringent regulation, long-term monitoring, and imposition of penalties to the violators of SUP users is required for complete elimination of the plastic pollution from the Himalaya. Major recommendations for curbing

the plastic pollution in the Indian Himalayan region includes:

- a. Time bound implementation of the Plastic Waste Management Rules, 2016 and strict monitoring of regulations for the imposition of penalties to the violators of SUP users.
- b. Targeted research and development for identification of alternatives to plastic products and technologies to use plastic waste for wealth and energy.
- c. Large scale commercial production of ecofriendly plastic alternatives and strengthening of market linkages between value chains for popularization of alternatives in competitive markets.
- d. Wide publicity of 9Rs i.e., Refuse, Rethink, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, Recycle, and Recover among the masses and businesses for the promotion of a circular economy in plastic products.
- e. Public awareness and outreach for the adoption of SUP alternatives and segregation at source for recycling of plastic waste.
- f. Improvement in waste management infrastructure including an efficient door-to-door collection system and waste recycling facilities.

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About the Institute:

G.B. Pant National Institute of Himalayan Environment, Kosi-Katarmal, Almora was established in 1988, during the birth centenary year of Bharat Ratna Pt. Govind Ballabh Pant, as an autonomous Institute of the Ministry of Environment, Forest & Climate Change (MoEF&CC), Govt. of India. The institute has been identified as a focal agency to advance scientific knowledge, to evolve integrated management strategies, demonstrate their efficacy for conservation of natural resources, and to ensure environmentally sound development in the entire Indian Himalayan Region (IHR).

The Institute follows a multidisciplinary and holistic approach in all its Research and Development programmes with emphasis on interlinking natural and social sciences and particular attention is given to the conservation of fragile mountain ecosystems, indigenous knowledge systems and sustainable use of natural resources. Training, environmental education and awareness to different stakeholders are essential components of all the R&D programmes of the Institute.



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