



Environment

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Preeti Sudan

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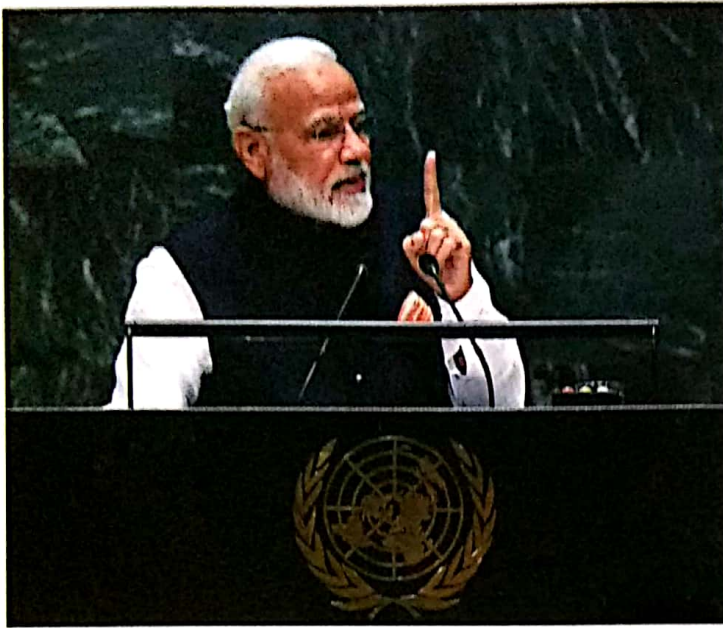
Prof. M.S. Swaminathan

FOCUS

Water Management:
Building a Resilient Nation
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The Prime Minister at the United Nations General Assembly



It is a great honour for me to address the 74th Session of the United Nations on behalf of 1.3 billion Indians.

When a developing country is able to successfully implement the world's biggest sanitation campaign, building over 110 million toilets in just 5 years for its countrymen, all its achievements and outcomes are an inspirational message for the entire world.

When a developing country, successfully runs the world's biggest health insurance scheme, giving 500 million people the facility of an annual health cover of Rs. 500,000 for free treatment; the achievements and responsive systems that result from this scheme show the world a new path.

As I came in here, on a wall at the entrance to this building, I noticed the sign, 'no more single use plastic' I am pleased to inform this assembly that

even as I am addressing you today, a very large campaign is being implemented across the entire country to make India free of single use plastic.

In the next 5 years, apart from promoting water conservation, we are going to ensure water supply to 150 million homes. We are going to build over 125,000 kilometers of new roads. By the year 2022, when India celebrates its 75th Independence day, we plan to build 20 million houses for the poor. Though the world may have set itself the target of eradicating TB by 2030, in India we are working towards eradicating it by 2025.

About 3000 years ago, a great poet of India, Kariyan Pungun-dra-naar, wrote in Tamil the most ancient language of the world: "Ya-dum, Oo-ray, Yaav-rum Ke-rir", which means "We belong to all places, and to everyone." This sense of belonging beyond borders, is unique to India.

In the last 5 years, India has worked towards strengthening its centuries old great tradition of fraternity among nations and welfare of the world, which is indeed, in line with the key objectives of the United Nations. The issues that India raises, the kind of new global platforms that India has come forward to build, seek collective efforts to address serious global challenges and issues.

If you look at it from a historic and per capita emission perspective, India's contribution to Global Warming is very low. However, India is one of the leading nations when it comes to taking steps to address this issue. On one hand, we are working towards achieving the target of 450 Giga Watts of renewable energy, and on the other hand, we have also taken the initiative to create the International Solar Alliance. One of the effects of Global Warming is the increasing number and severity of natural disasters, and at the same time they are appearing in new areas and in new forms. In view of this, India has initiated the formation of the "Coalition for Disaster Resilient Infrastructure" (CDRI). This coalition will help build infrastructure which can withstand natural disasters.

The face of the world is changing today. Modern technology in the 21st century is bringing about sweeping changes in social life, personal life, economy, security, connectivity and international relations. Neither do we have the option to confine ourselves within our boundaries. In this new era, we will have to give new direction and energy to multilateralism, and to the United Nations.

One hundred and twenty-five years ago, the Great Spiritual Guru, Swami Vivekananda, gave this message to the world during the World Parliament of Religions in Chicago. The message was, "Harmony and Peace... and not Dissension".

Today, the message from the world's largest democracy, for the International community is still the same: "Harmony and Peace".

(Excerpts from the PM's speech at UNGA on 27 September, 2019)

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Let noble thoughts come to us from all sides
Rig Veda

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"Those years [1960s], there were very
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Time to Act

The air quality index touches alarmingly dangerous levels frequently; contamination of groundwater is a stark reality of today; water tables are receding; oceans are rising; air is being polluted by vehicles and industries; plastic waste is clogging the entire ecosystem and landfills are becoming a part of the skyline of our cities.

The environment is showing signs of this degradation which is bound to affect each one of us. Frequent floods, drought, abrupt weather cycle, crop pattern changes, receding coastal areas are some of these red flags glaring at the humanity. Decades of environmental decay is eventually posing threat to the entire ecosystem we are in – living standards are compromised, health is affected, and above all, it questions the entire existence of the current models of growth and development.

Sustainability and development need to go hand in hand. The waste we generate, if not properly managed, is a burden to the environment – single-use plastic is an evident example of this use-and-throw culture of waste generation we have developed over the years. There is an economy around environment, and also the economy in general is impacted by climate change and its mitigation. This poses a challenge and also an underlying opportunity.

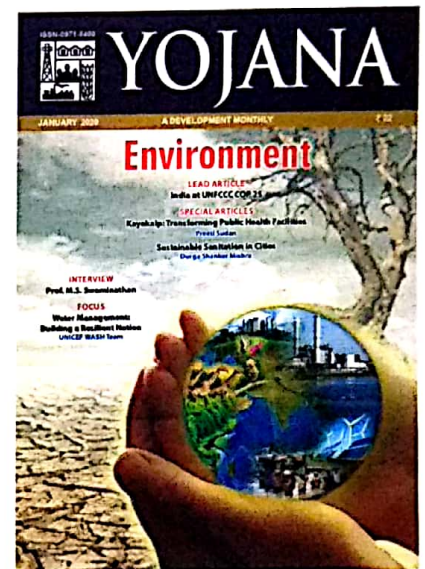
Environment is a typical case of what we sow, so we reap. Our collective actions impact the environment we share, as climate change doesn't distinguish between rich and poor. With the time running out to contain the ill-effects on environment, the recently held Conference of the Parties under the United Nations Framework Convention on Climate Change (UNFCCC COP 25) in Madrid, Spain was seen as a window of opportunity. Together, the world has to come to a consensus to stand as one to overcome this challenge.

India has shown leadership and commitment on environmental issues. Achieving targets for renewable energy under the Paris Agreements push for e-vehicles and vehicle emission norms, Coalition for Disaster Resilient Infrastructure and International Solar Alliance are some of the fronts in which India has led by example.

This issue of Yojana gives detailed analyses on an array of topics concerning environment. We are fortunate to have the perspective of Prof. M.S. Swaminathan in the issue, who has been contributing to Yojana since 1960s and has shared his profound views on promoting sustainable agriculture and climate change.

The environment is at the brim. It is our collective responsibility to work together for providing a brighter future for the coming generations – a lifestyle that is self-sustaining, resources that are adequate for all, development that is not compromising our ecosystem, flora-fauna and wildlife that are in safe hands and the land, water and air that are fit for humans and other forms of life.

This Environment issue of Yojana is a reminder of what Gandhiji had envisioned by saying, 'the world has enough for everyone's need, but not enough for everyone's greed.' The time to act is now. □



India at UNFCCC COP 25

The Union Minister for Environment, Forest and Climate Change (MoEF&CC), Information & Broadcasting and Heavy Industries & Public Enterprises Shri Prakash Javadekar delivered India's Statement at the 25th session of Conference of Parties under the UN framework convention of Climate Change (UNFCCC COP 25), in Madrid, Spain on 10 December, 2019.

Following is the Statement (Excerpts):

Madam President, Excellencies, Ladies and Gentlemen,

At the outset I would like to quote Mahatma Gandhi who said "The future depends on what we do today".

I would like to convey our appreciation to the Government of Spain for hosting COP 25 at a short notice and for making excellent arrangements. We assure the Presidency of Chile of our full support for a successful COP.

Climate change is real. The world recognised it and adopted a comprehensive agreement in Paris. Let us concentrate on implementation of Paris Agreement and not digress. If there is an inconvenient truth in the form of climate change, we are providing a convenient action plan. We are walking the talk.

India has reduced emissions intensity of GDP by 21 percent and is on track to achieve the goal of 35% emissions reduction as promised in Paris.

Prime Minister Modi announced 175 Giga Watts targets for renewables under Paris Agreement. We have already achieved 83 Giga Watts. Prime Minister has subsequently increased



the target to 450 Giga Watts at the recent UN Climate Action Summit. We are simultaneously progressing on solar, biomass and wind energy.

We have put carbon tax on coal production at the rate of Dollars 6 per tonne. Even with 36 parties represented in Parliament, we could achieve this unanimously.

The headline is that a commercial flight was operated on 100 percent biofuel and we are targeting blending of 20% ethanol in petrol by 2030. We have leapfrogged from Bharat Standard IV to Bharat Standard VI for vehicle emission norms and from 1 April, 2020, vehicles will be BS VI compliant.

360 million LED bulbs have been fitted in homes, and 10 million conventional streetlights have been replaced with LED lights. There is also a strong push for use of e-vehicles by introducing multiple policy interventions and incentives. We have provided 80 million LPG gas

connections replacing conventional firewood cooking stoves. Our cooling action plan and adaptation plan are working well and will achieve our targets.

We have promised creation of additional carbon sinks of 2.5 to 3 billion tonnes of carbon equivalent through increasing green cover. In last five years, our green cover has increased by 15,000 sq. km. We are undertaking special projects like urban forests, school nursery, agroforestry, water and fodder augmentation in the forest area.

India prioritises adaptation as an integral part of climate actions. Therefore, India will be investing about 50 million dollars in water conservation. India has taken up a target for restoration of 26 million of degraded land by 2030 during the 14th COP of UN Convention to Combat Desertification in Delhi. This is one of the largest programs in the world to ensure carbon sink in land resources. 100% neem coating of urea fertilizer

BASIC Ministerial Joint Statement at UNFCCC COP 25

Following is the BASIC Ministerial Joint Statement at the 25th session of Conference of Parties under the UN framework convention of Climate Change (UNFCCC COP 25), in Madrid, Spain.

1. The Ministers of the Brazil, South Africa, India and China group (BASIC) met during the 25th Conference of Parties to the United Nations Framework Convention on Climate Change (COP 25) in Madrid, Spain, on 10th December 2019. The meeting was chaired by H.E. Mr. Zhao Yingmin, Vice Minister of Ecology and Environment of the People's Republic of China, and attended by H.E. Mr. Ricardo Salles, Minister of the Environment of Brazil, H.E. Ms. Barbara Creecy, Minister of Environment, Forestry and Fisheries of the Republic of South Africa, and H.E. Mr. Prakash Javadekar, Minister for Environment, Forest and Climate Change and Information and Broadcasting of the Republic of India.
2. The Ministers pledged their full support to the Chilean COP Presidency, expressed their gratitude to the Kingdom of Spain for hosting the meeting and noted that the central mandate of COP 25 is to prepare the way for the full implementation of the Paris Agreement in the post-2020 period building upon the climate action efforts under the Convention and its Protocol. They further stated that the progress on the pre-2020 agenda will be the benchmark of success for this COP. The Paris Agreement, adopted under the United Nations Framework Convention on Climate Change, represents a key milestone in the progressive development of multilateralism to enable the international community to collectively address climate change, which is of pressing global concern. The Ministers stressed that this achievement will be defended and built upon and called upon the international community to focus on the comprehensive and faithful implementation of the Paris Agreement.

Such implementation must be in accordance with the Convention's goals and principles, including the principles of equity and common but differentiated responsibilities and respective capabilities, in light of different national circumstances.

3. Ministers underlined that COP 25 should achieve outcomes as follows:
 - i) To conclude the negotiations related to article 6 of the Paris Agreement;
 - ii) To mandate a 2-year Work Programme under SBI to assess the pre-2020 progress and gaps, with a view to making the necessary arrangements to fill those gaps;
 - iii) To urge developed country Parties to fulfil their commitments on providing finance, technology development and transfer and capacity-building support to developing countries;
 - iv) To interpret and implement the provisions of the Paris Agreement in a holistic and faithful manner.
4. Ministers underscored the importance of concluding the discussions on Article 6 of the Paris Agreement, in accordance with the mandates and principles set out in the Agreement and the accompanying decision, including ensuring environmental integrity. Ministers emphasized the importance of keeping a balance of the mechanisms under Article 6.2 and Article 6.4, that share of proceeds should be collected under both Article 6.2 and Article 6.4, to contribute to Adaptation Fund. A decision on Article 6, including its governance and a smooth transition from the Clean Development Mechanism would preserve the integrity and credibility of the multilateral system and send a strong message to the private sector on their engagement and crucial role in achieving the objectives of the agreement. Any unilateral measures and discriminatory practices that could result in

is appreciated by the world and 170 million soil health cards are taking care of the soil health, thus creating more carbon sinks.

Internationally, we launched the Coalition for Disaster Resilient Infrastructure which is a partnership to support countries through knowledge exchange and provide technical support on developing disaster and climate resilient infrastructure.

Only 6 countries are on track to

meet their NDCs announced in Paris. We are leading the pack. Sustainable lifestyle is a part of the ethos of India.

It is time for reflection and assessment as we near the end of Pre-2020 period. It is time to look in the mirror. Has developed world delivered on its promises? Unfortunately, annexed countries have not met their Kyoto Protocol targets. Neither their NDCs reflect ambitions nor have they shown willingness to enhance their

commitments. I propose that we have three more years to fulfill pre-2020 commitments till the global stock take takes places for bridging emission gaps.

I draw your attention to very important issue of finance. Developed world promised 1 trillion dollar in last 10 years, and not even 2 percent has materialised. It has to be public finance and there should be no double accounting. The world that benefited

market distortion and aggravate trust deficit amongst Parties must be avoided.

5. Recalling that the Paris Agreement represents a delicate political balance negotiated amongst 195 Parties with diverse levels of development and distinct national circumstances, the Ministers expressed grave concern regarding the current imbalance in the negotiations. In particular, there has been a lack of progress on the pre-2020 Agenda, adaptation and issues related to means of implementation support, in the form of climate finance, technology transfer and capacity building support, which is essential to empower developing countries to contribute their best effort to the international community's collective response to climate change. This imbalance needs to be immediately rectified, in the interests of a successful conference outcome and achieving the global goals in the Paris Agreement.
6. Ministers reiterated that ambition of Parties is measured first and foremost by the implementation of its commitments. Commitments made by developed countries in the pre-2020 period must be honoured, because the completion of the pre-2020 Agenda is of critical importance in building the basis for mutual trust and ambition in the post-2020 period. The pre-2020 gaps with regard to mitigation, adaptation, means of implementation and reporting by developed countries must be assessed and closed, without transferring any burden to developing countries. The pre-2020 Agenda will be concluded when the pre-2020 ambition gaps have been closed and not at the end of this conference. The ambitious implementation of developed countries' commitments to provide support to developing countries is a precondition to any discussion on progression of current commitments.
7. Ministers underscored that the periodic review of the long-term global goal under the Convention and of overall progress towards achieving it, is a mechanism with clear mandates under the UNFCCC and an important process that reaffirms the Convention as

the preeminent international forum for addressing climate change. Ministers stressed that the scope of the periodic review is different from the 2-year pre-2020 Work Programme and Global Stocktake, since each of these processes have their specific technical arrangements. In the design of the periodic review, coordination with and requests for information to relevant bodies will to avoid duplication of work. The outcome of the 2-year pre-2020 Work Programme could feed into the periodic review as an element, and together the two processes should serve as a useful input to the Global Stocktake.

8. Ministers highlighted that BASIC countries are implementing ambitious climate actions based on their national circumstances and have achieved great progress, contributing significantly to global efforts in combating climate change. This is notwithstanding the insufficient and uneven progress of their domestic development and the multiple challenges all BASIC countries face, including in poverty eradication and achieving socio-economic development and environment protection. In 2018, China reduced carbon dioxide emissions per unit of GDP by 45.8% from 2005 levels, as well as increased the share of non-fossil fuels in primary energy consumption to 14.3%. South Africa has recently implemented a carbon tax and announced a massive renewable energy program in its latest electricity plan. India has already achieved a 21% reduction in emission intensity of GDP in 2014 compared to 2005 levels, thereby achieving its pre-2020 voluntary target. In 2015, Brazil had already achieved a 58% emission reduction relative to the business as usual scenario set for its NAMAs, thereby overachieving its target of 36%-39% reductions set for 2020. BASIC countries have already set forth climate policies and contributions reflecting our highest possible ambition, above and beyond our historical responsibilities. The time for action is now, and not next year or thereafter.

Source: Press Information Bureau

from carbon emissions that made them developed, must repay.

Technology development and transfer at affordable costs is crucial for developing countries. If we are dealing with a disaster, nobody should profit from it. So, my proposal is to have more joint research and collaboration, grant finance made available for meeting the targets.

COP 25 is an important step in our collective journey towards

a clean, green and healthy planet. Market and non-market mechanisms play an important role. We expect that guidelines for Article 6 will ensure transition of Clean Development Mechanism under Kyoto Protocol and provide the incentives and positive signals to private sector, which had invested in it. We also urge support for the vulnerable communities worldwide with a strong Warsaw International Mechanism for Loss and Damage with provision for financial support.

This is the time for ownership and this is the time for responsible action. India has and will continue to do its bit - expecting commensurate multilateral action with developed countries taking the lead.

Let me end by quoting Thoreau, "What is the use of a house, if you haven't got a tolerable planet to put it on?" □

(Source: Press Information Bureau)

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Kayakalp: Transforming Public Health Facilities

Preeti Sudan

Kayakalp initiative of the Ministry of Health & Family Welfare began in 2015 with the aim of improving infrastructure upkeep, hygiene and sanitation, and infection control practices in Central Government institutions and public health facilities in all States and UTs.

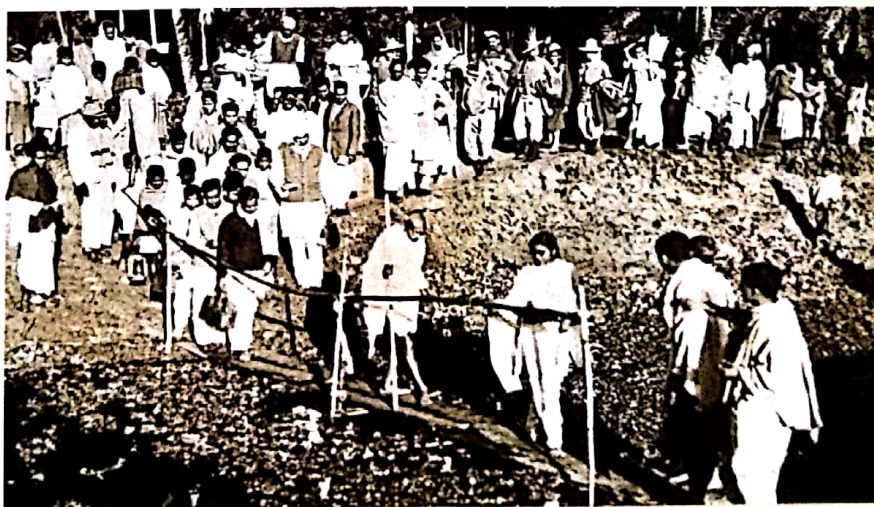
Mahatma Gandhi and Sanitation

The Father of the Nation, Mahatma Gandhi was concerned for public and private sanitation which was also a part of his *Satyagraha* campaign since the days he spent in South Africa. For Gandhiji, the drive for cleanliness in society was an integral part of the process in bringing about a casteless and free society. **"Everyone is his own scavenger,"** said Gandhiji, reiterating the fact of making cleanliness a personal responsibility and the key to removing untouchability. In South Africa itself, Gandhiji took to scavenging and propagated the advice among Indians to keep their lavatories clean and dry. Once he returned to India, his focus on sanitation grew stronger. He firmly emphasised on the need for education on hygiene and sanitation among Indians and stated **"the scavenger's work must be our special function in India."** Gandhiji laid down the need for having clean water and air and the precise method of dealing with open defecation. **"Swaraj ought to begin with our streets,"** he always said.

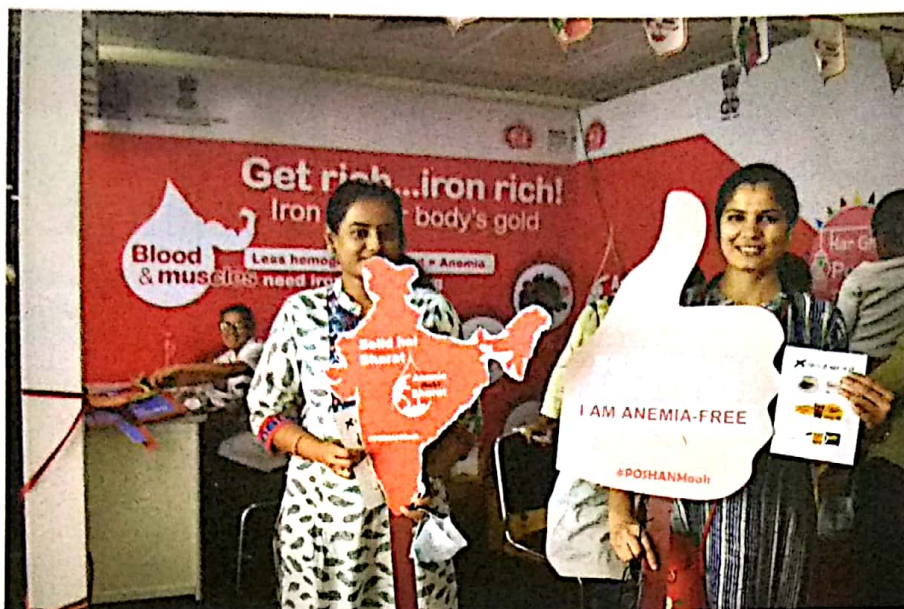
Gandhiji has said, **"Sanitation is more important than Independence"**. Our Hon'ble Prime Minister took inspiration from Gandhiji's ideas on hygiene and started a campaign, 'Swachh Bharat Abhiyan' or 'Clean India Mission'

on his 145th birth anniversary. This mission aimed to eradicate open defecation by 2 October, 2019, the 150th birth anniversary of Mahatma Gandhi, by constructing 9 crore toilets in rural India at a projected cost of Rs. 1.96 lakh crore, spanning 4,041 statutory cities and towns. The drive has been categorised in two sub-missions, Swachh Bharat Abhiyan (Urban) that operates under the Ministry of Housing and Urban Affairs and Swachh Bharat Abhiyan (Rural) that falls and operates under Ministry of Jal Shakti (erstwhile Ministry of Drinking Water and Sanitation). This mission became a national priority and the Prime Minister urged every Indian to join it and clean up the areas around them.

This October, as we celebrated the 150th birth anniversary of Gandhiji and the third anniversary of Swachh Bharat Abhiyan, the Prime Minister drew on Gandhiji's views on sanitation to emphasise the fact that Mahatma Gandhi's dream of a Clean India can only be realised when 125 crore people come together. This mission is directly linked with the economic health of the nation and its accomplishment will not only contribute to the GDP growth of the country but will also reduce the associated health costs. Swachh Bharat Abhiyan has been an internationally acclaimed, country-wide, visionary programme which aims to spread the message of "Swachhata" across each household, village, and city of India.



The author is Secretary, Ministry of Health & Family Welfare, Government of India. Email: secyhw@gmail.com



To contribute to this national movement and addressing the growing challenges of sanitation and hygiene, the Ministry of Health & Family Welfare adopted a multi-pronged strategy and launched many initiatives for improving hygiene and sanitation holistically. Since 2015, it has particularly made sanitation a centrepiece of its efforts to improve the health and wellbeing of our citizens. These initiatives address hygiene and sanitation within health facilities as well as in the community through its own programmes and also in partnership with other Ministries to address the issue holistically.

Kayakalp initiative of the Ministry of Health & Family Welfare began in 2015 with the aim of improving infrastructure upkeep, hygiene and sanitation, and infection control practices in Central Government institutions and public health facilities in all the States and UTs. Health facilities are assessed and scored on a number of parameters,

and every year the highest-scoring facilities at each level receive recognition through Kayakalp Awards that carry cash, apart from the citation. The scheme has resulted in significant improvement in the level of the cleanliness, hygiene, and infection-control practices at public healthcare facilities and has inculcated a culture of ongoing assessment and peer review to promote hygiene, cleanliness, and sanitation. For ensuring the objective assessment of "Swachhata" at the public health facilities, assessment is done under seven thematic areas. Trainings are provided for not only undertaking the assessment but also for implementation of correct protocols and practices. Trained assessors undertake the final assessment and generate a score for short-listed health facilities. Kayakalp has not only been able to facelift the public health facilities but has made significant contribution towards moulding the behavioural practices of the public. This paradigm shift is well reflected in

The Ministry of Health & Family Welfare adopted a multi-pronged strategy and launched many initiatives for improving hygiene and sanitation holistically. Since 2015, it has particularly made sanitation a centrepiece of its efforts to improve the health and wellbeing of our citizens.

the number of "satisfied" patients as reported through "Mera Aspataal", an ICT-based patient feedback system.

Kayakalp made a modest beginning in its first year with assessing only the District Hospitals (DH). Subsequently, within a span of three years, all the Sub District Hospitals, Community Health Centres, and Primary Health Centres (Rural and Urban) have also been brought under its ambit. The number of facilities participating in Kayakalp has increased manifold. Starting with participation of 700 DHs, in the last financial year, approximately 26,000 health facilities have participated in Kayakalp. Not only the number of facilities participating under the initiative has multiplied, the number of facilities scoring 70% (passing criteria) or more has also increased manifold over the years. Apart from the gargantuan participation of the primary and secondary-level healthcare facilities, tertiary-level healthcare facilities participate with the same vigour and enthusiasm. With participation of 10 facilities in year 2015-16, the number has risen to 24 Central Government institutions in the year 2018-19. Taking a step ahead, from FY 2019-20, Kayakalp has now been introduced to Ayushman Bharat-Health and Wellness Centres (AB-HWCs). Also, in order to ensure that "voice of patients, the health clients" is heard and their feedback is obtained for each of the facilities visited by them, the data of 'Mera Aspataal' has been linked up to Kayakalp scoring for DHs.

In the current year, for holistic and comprehensive improvement across the health sector, the Kayakalp scheme has been extended to the private sector health facilities. Quality Council of India (QCI) through its constituent National Accreditation Board for Hospitals & Healthcare Providers (NABH) conducted Kayakalp assessment in the private hospitals. The assessments were conducted as per the Kayakalp

guidelines established by MoHFW encompassing parameters viz. hospital/facility upkeep, sanitation and hygiene, waste management, infection control, hospital support services, and hygiene promotion. QCI conducted Kayakalp assessments in 653 private hospitals pan India within a duration of two months. The hospitals were classified in three categories and out of the 653 facilities, 635 hospitals were found compliant with Kayakalp Guidelines.

MoHFW has also used the platforms of Village Health Sanitation and Nutrition Committees (VHSNCs) under the National Health Mission and Mahila Arogya Samitis (MAS) under the National Urban Health Mission (NUHM) to promote sanitation in the vulnerable urban communities. Many States have adopted innovative practices in making VHSNCs and MAS effective. Accredited Social Health Activists (ASHAs) also work with VHSNCs to mobilise the community for construction and use of toilets. MAS are recently established community groups of about 12 to 20 women from primarily poor and vulnerable populations in urban areas, and they are working for mobilising communities on a range of issues, including sanitation.

Not only healthcare professionals or health department, MoHFW has worked on inter-ministerial collaboration for hygiene and sanitation. Leveraging the momentum achieved under Kayakalp, MoHFW and Ministry of Jal Shakti started an integrated scheme, the "Swachh Swasth Sarvatra" in December 2016.

Kayakalp made a modest beginning in its first year with assessing only the District Hospitals (DH). Subsequently, within a span of three years, all the Sub District Hospitals, Community Health Centres, and Primary Health Centres (Rural and Urban) have also been brought under its ambit. The number of facilities participating in Kayakalp has increased manifold.

Under this initiative, resources have been provided to CHCs located in Open Defecation Free (ODF) blocks which are yet to meet the Kayakalp criteria. In 2019, the country's three best PHCs under Kayakalp from Andhra Pradesh, Gujarat, and Karnataka were also felicitated by Ministry of Jal Shakti.

Efforts made under Kayakalp and Swachh Bharat Abhiyan have been well recognised by the WHO as well, which mentions that nearly all (97%) DHs now have some or the other form of proper waste management.¹ Swachh Bharat Abhiyan along with Kayakalp has given thrust to the country's efforts to achieve Sustainable Development Goal 3 (Good health and well-being) and Goal 6 (Clean water and sanitation) respectively. As reported by the WHO, it is expected that Swachh Bharat Abhiyan will result in averting more than 3,00,000 deaths (diarrhoea and protein-energy malnutrition) between 2014 and October 2019. More than 14 million DALYs (Disability-Adjusted Life Years) are estimated to be avoided (diarrhoea and protein-energy malnutrition) between 2014 and October 2019.²

The achievements under the Swachh Bharat Abhiyan are

applaudable. As many as one crore household toilets have been built since its launch in October 2014, almost 6 lakhs villages have been declared ODF villages and 35 States/UTs too are now ODF. The initiative has been able to create a ripple of improvement in public health sector and has been possible because of the collaborative efforts of all States. This being said, the overall activities to maintain hygiene have now developed into a habit, sustaining a Kayakalp certification or an ODF certification has led to people practicing hygiene practices in their daily lives. Not only have hygiene habits lead to overall positive health outcomes (reduction in hospital-acquired infection, reduction on antibiotic use etc.) the clean facilities have given a takeaway message to people to also keep their home and surroundings clean and that is an impact beyond the four walls and boundaries of a public health facility, indeed. The synergy and momentum achieved under Swachh Bharat Mission shall continue to expand and deliver a 'Clean India, a Healthy India'. □

Endnotes

1. WASH in HEALTH CARE FACILITIES, Global Baseline Report 2019
2. <http://www.searo.who.int/india/mediacentre/events/2018/swachh-bharat-report-web.pdf>

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Sustainable Sanitation in the Cities

Durga Shanker Mishra

Focus on creating sustainable infrastructure, systems, and processes have been the hallmark of the Government of India's approach to urban sanitation in the last five years; it is to set a path for institutionalising 'swachhata'. An enabling environment would need to be created through conducive policy support and reforms, leveraging technology for Mission implementation, robust and real-time, data-driven monitoring supported by third-party verifications, capacity building of municipal staff, and private sector participation to sustain the sanitation outcomes achieved and the momentum generated.

Urban Sanitation in India

The Census (2011) revealed that 12.6% of households in Urban India were practising Open Defecation (OD). While this was definitely lower than the extent of OD (68%) in rural India, it was nonetheless adversely impacting the health of urban citizens and the overall environment. Moreover, with only 38% coverage of septic tanks and less than 33% coverage of sewerage network in the country, more than 70% of the discharge from the toilets, be it from household or from community/public toilets, were being disposed off in an unsafe manner. A bigger cause of worry was that 75% of fresh water resource used for drinking purpose was contaminated with sewage contributing to 60% of total pollution load (CPCB Report, 2009).

The Cost of Poor Sanitation

The Sustainable Development Goals (SDGs) place significant emphasis on sanitation, cleanliness, and hygiene. There is significant evidence globally that better sanitation, hygiene, and cleanliness help in effective control of various vector-borne diseases, parasite infections, and nutritional

deficiencies. There have been studies linking cleanliness and hygiene with reduction in gastrointestinal diseases (especially diarrhoea), psychological issues, and allergic conditions. As per a UNICEF report (2011), almost 90% of child deaths from diarrhoeal diseases are directly linked to contaminated water, lack of sanitation, or inadequate hygiene. In addition to the impact on the communicable diseases, better sanitation leads to reduction in occurrences of low birth weight in babies, spontaneous abortions, and occurrences of birth defects. Studies have proved that improvement in sanitation and hygiene results in better health outcomes.

As per the India Health Report for Nutrition Security in India (PHFI, 2015)¹, the North Eastern State of Mizoram has reported a 13 percentage-point decline in stunting (below normal height for the age) and five percentage points decline in underweight children (underweight and short) between 2006 and 2014 due to improved access to sanitation. Improved sanitation has been shown to have significant impact not only on health, but also on social and

economic development, particularly in developing countries. For example, an independent study conducted by UNICEF in India² in August 2017 established that every Indian family will save about Rs. 50,000 annually if open defecation is eliminated.

Journey to Sustainable Urban Sanitation

On 2 October, 2019, Urban India became Open Defecation Free (ODF)- a fitting tribute to Mahatma Gandhi on his 150th birth anniversary. This historical feat achieved in only a short span of five years was remarkable, given that no Government programme till date had focused on the issue of urban sanitation. In the intervening five years, not only was the sanitation objective of the Mission fulfilled, but lakhs of citizens, especially women, have been provided dignity and safety and significant reduction in vector-borne diseases with consequent improvement in health parameters has been experienced, setting urban India on the path of holistic cleanliness.

The Ministry of Housing and Urban Affairs (MoHUA) has been implementing various Missions of the

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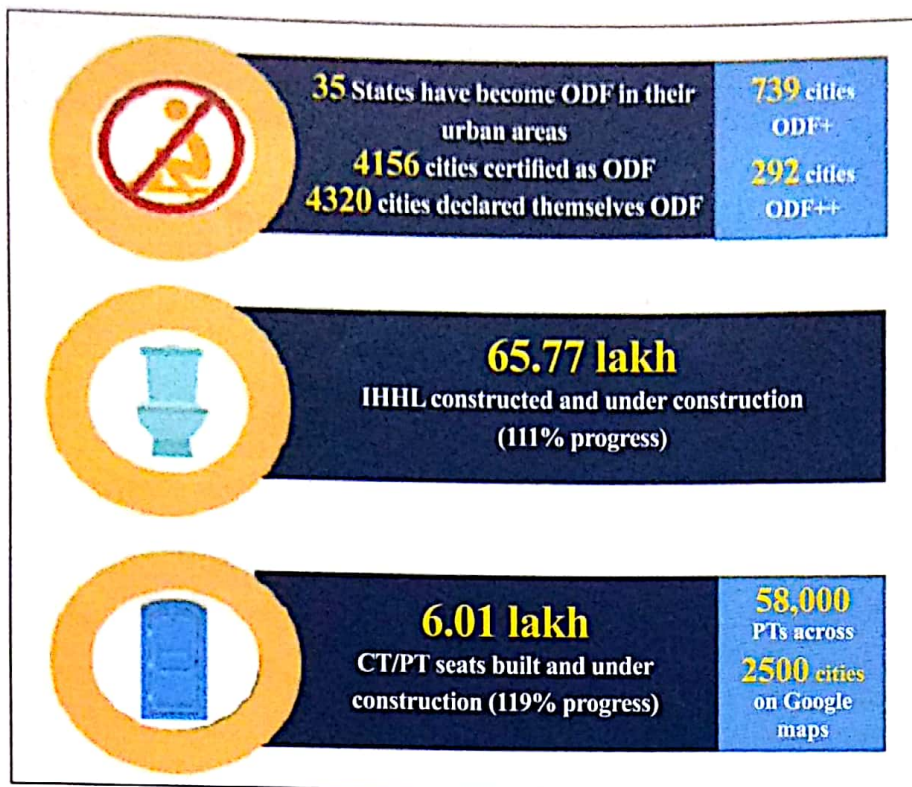


Figure 1: Progress in Urban Sanitation

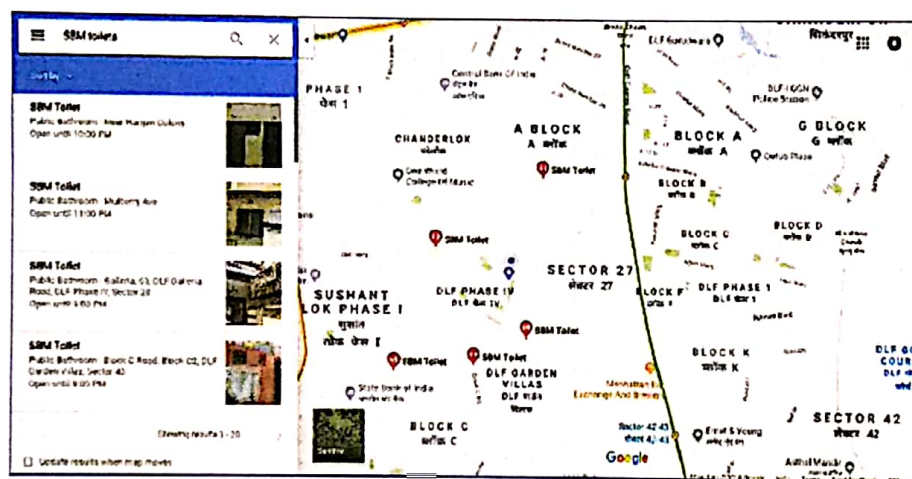


Figure 2: Public Toilets (SBM Toilets) on Google maps

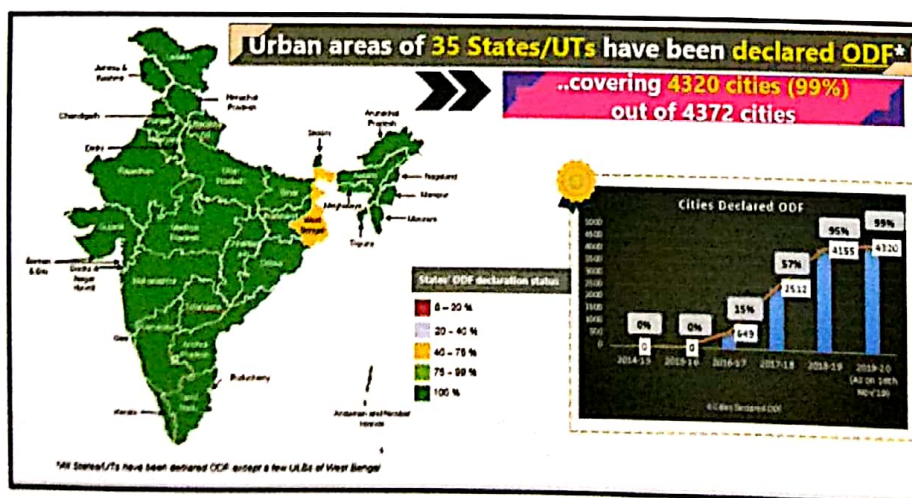


Figure 3: Progress of ODF cities

Government of India, viz. Swachh Bharat Mission (Urban), AMRUT, Smart Cities Mission, NERUDP - all of which address the issue of urban sanitation. Over the last five years, the urban sanitation initiatives of the Government have achieved impressive success (Figure 1), with more than 99% of its cities and 35 States/UTs having become ODF (under Swachh Bharat Mission-Urban).

MoHUA has also partnered with Google to upload and make available on Google maps all the public and community toilets in the cities (Figure 2) so that citizens and visitors are able to easily locate these facilities in their vicinity. Till date, 58,000 public toilets (including 500 from NHAI) across 2,500 cities are visible on Google maps.

The year-wise ODF journey of Urban India is depicted in Figure 3.

A Graded Approach to Scaling Up and Sustaining Urban Sanitation

Since the beginning, the question that was upper most in our minds was how the ODF status of cities could be sustained without slippage. Hence, we launched the ODF protocol, a first-of-its-kind initiative in the country where an independent third party would certify a city as ODF on satisfactorily complying with the protocol requirements (Box 1).

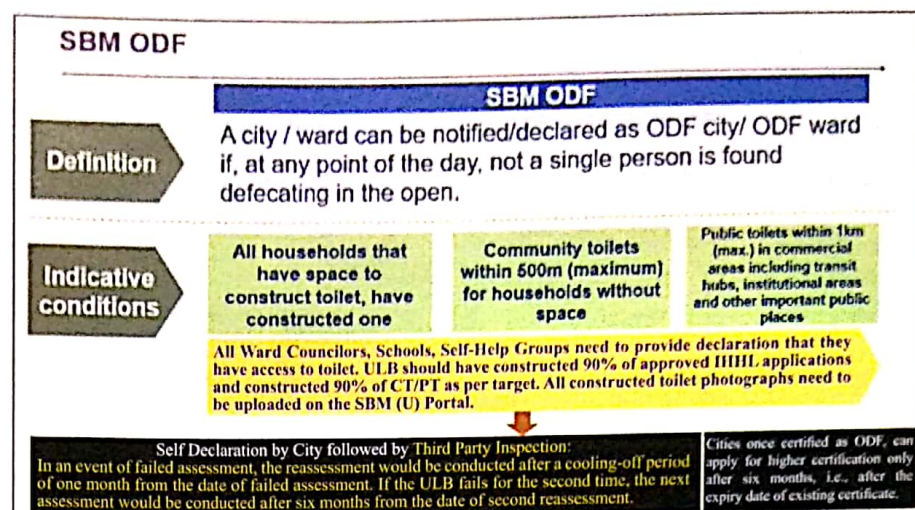
Moreover, in order to prevent slippage of ODF status, the ODF certificate was made valid only for 6 months; beyond which the city had to be recertified as ODF by the third party.

However, we realised that it was not enough to address all the sanitation challenges that a city faces merely by making them ODF. For example, how would households with space constraints, residents of slum colonies, a visitor to a city, or any floating population respond to nature's call? Where would they get access to clean, functional, and usable toilets? While community/public toilets were being constructed in urban areas, they

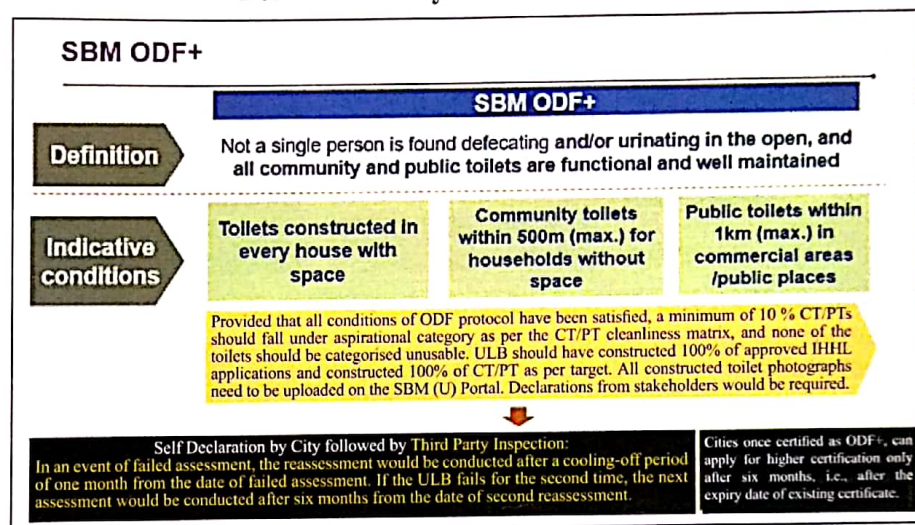
were plagued by poor operation & maintenance challenges, rendering them virtually unusable and non-functional, forcing people to continue with OD and open urination. The next logical step therefore was to draw up a standard protocol – the ODF+ protocol – for maintaining acceptable levels of cleanliness of community/public toilets, so that they are functional, usable, hygienic, and hence actually used by citizens. The ODF+ protocol was therefore launched, again with the requirement for third party certification as the ODF protocol (Box 2).

The next level of challenge faced was while toilets were now functional and being used, so that OD and open urination were curbed, what was happening with the faecal sludge being discharged from these toilets? How would it be managed safely so that they do not pollute the environment? The fact that most of the faecal sludge was ending up as open discharge in fields and water bodies meant that it was posing even greater danger to the environment compared to OD. In fact, as per calculations, one truck of faecal sludge and septage carelessly dumped is equivalent to 3,000 people defecating in the open! Hence, our next endeavour at sustaining the sanitation impacts was to launch the ODF++ protocols to address the issue of complete faecal sludge management, involving scheduled emptying of septic tanks, safe containment and transportation, and finally, safe processing of the faecal sludge and septage. In this, we encouraged cities to adopt cost-effective and decentralised options – be it co-treatment in STPs, low cost FSTPs, DRE, etc., rather than going for more capital-intensive options such as sewer networks. (Box 3).

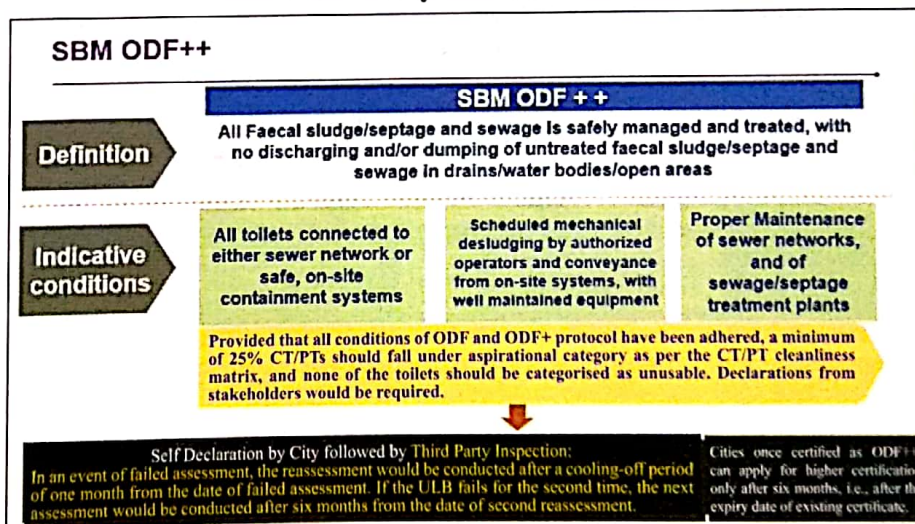
The cities and States/UTs have responded enthusiastically to these protocols, and our journey towards sustainability has already begun on a promising note. As on date, we have 739 cities already certified ODF+, and 292 cities certified ODF++. Under AMRUT Mission too, significant



Box 1: Necessary Conditions for ODF



Box 2: Necessary Conditions for ODF+



Box 3: Necessary Conditions for ODF++

progress has been made in Faecal Sludge management coverage with 637 projects already completed in Sewerage and Septage Management.

However, there was still some distance left to traverse. While the faecal sludge was now being managed

safely, the waste water (grey water and black water from household kitchens and toilets) were flowing into open drains and polluting our water bodies. Given the water crisis that our nation is facing, this was an added burden on our water resources that we could

(Box 4). Figure 4 presents summary of these protocols.

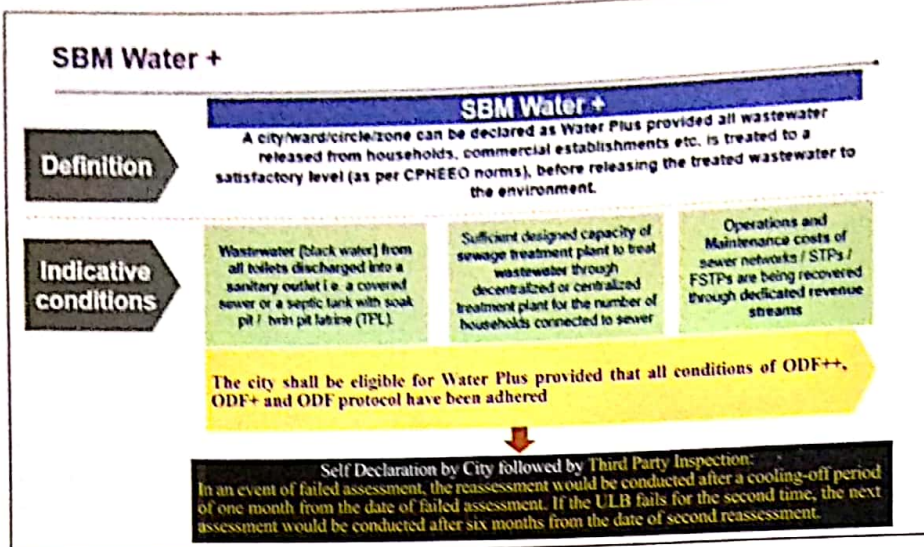
Given the capacity constraint of ULBs and the multiple challenges of sustainable sanitation, we consciously took a graded approach to sustainability, gradually capacitating ULBs to address their sanitation-related issues in an incremental manner, so that the results would be sustainable in the long run.

Swachh Survekshan – A Tool for Mission Monitoring and Governance

The Swachh Survekshan (SS) is an innovative survey conducted by MoHUA under the Swachh Bharat Mission-Urban, to rank cities on various sanitation and cleanliness parameters (Figure 5).

The survey has been successful in enthusing cities with a spirit of healthy competition towards the concept of 'swachhata'. In its first round in 2016, the SS was conducted among 73 cities with population of 10 lakh and above, and State/UT capitals of India. In 2017, the survey was conducted among 434 cities. Swachh Survekshan 2018 covered 4,203 ULBs: Indore was adjudged the cleanest city in the country. This survey, the first ever Pan-India Sanitation Survey impacting around 40 crore people, was probably the largest such survey in the world. Swachh Survekshan 2019 covered 4,237 cities. Indore once again emerged as the cleanest city in the country. The SS 2019 was unique as the service level assessment was completely online and paperless. In fact, in the area of urban sanitation, the issue of safe Faecal Sludge Management has received huge impetus and traction, thanks to the Survekshan, given that a major scoring criterion is achievement of ODF++ certification by a city.

For Swachh Survekshan 2020, MoHUA has introduced the concept of 'continuous Survekshan' to ensure that the Mission outcomes are sustained through a system of continuous monitoring and verification.



Box 4: Necessary Conditions for Water Plus

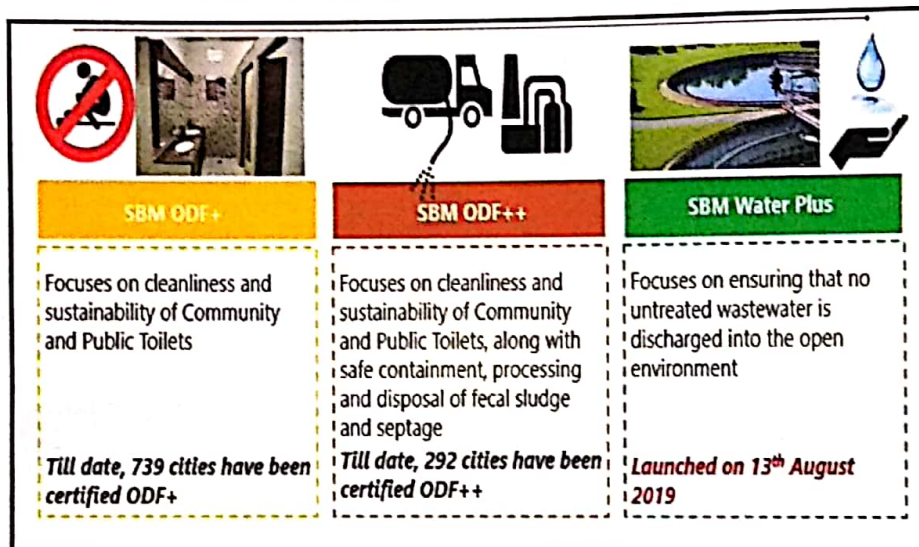


Figure 4: Sanitation Protocols

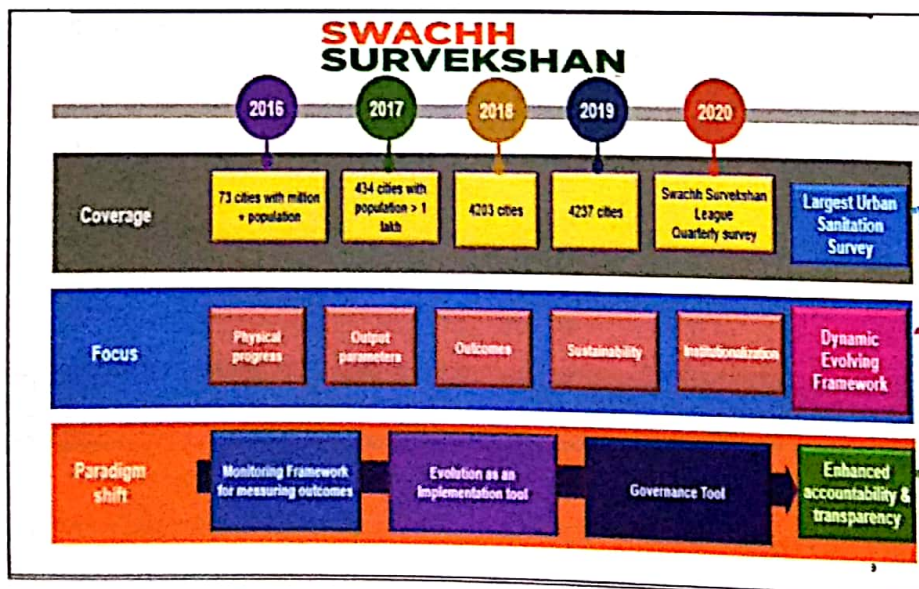


Figure 5: Swachh Survekshan – A Mission Monitoring and Governance Tool

hardly afford. Hence, in order to address this last-mile challenge of sustainability, we have now introduced

the Water Plus protocol to ensure that no untreated waste water is released into the environment or water bodies

Addressing the Challenge of Manual Scavenging and Hazardous Entry

Various laws and regulatory reforms have been enacted by the Government to ensure that the practice of manual scavenging is eliminated comprehensively. Though the practice of manual entry into sewers and septic tanks is allowed only under very special circumstances and only with proper protective equipment and safety gear, this practice still continues widely, often without proper safety precautions or safety gear being used, because of lack of enforcement and inadequate infrastructure, leading to fatal accidents. MoHUA has been constantly endeavouring to ensure that hazardous cleaning of sewers and septic tanks is completely eliminated, and even when manual entry is unavoidable, to ensure that it be done only with proper safety precautions. Such incidents of fatal accidents and deaths suffered by sanitary workers while cleaning sewers and septic tanks continue to plague our social consciousness. In this context, MoHUA has further strengthened its drive towards sustainable sanitation by mandating the setting up of Emergency Response Sanitation Unit (ERSU) in major cities, which represents an innovative approach to institutionalising safety practices and mitigating measures to counter manual scavenging and hazardous cleaning practices, while systematising human entry into sewer/septic tanks in a professional, well-trained, motivated, and appropriately equipped manner.

Other Key Enablers: Leveraging Technology, Intensive Behaviour Change & Capacity Building of ULBs

In addition, MoHUA's initiatives in urban sanitation have been complemented significantly through a variety of enablers, viz.

- Leveraging technology and 'smart' solutions to widen citizen outreach (e.g. Google mapping

of public toilets, Swachhata app as a Citizens' grievance redressal system on all aspects of sanitation);

- Robust online MIS and portal for real time data capture;
- Swachh Manch for large scale citizen engagement;
- Behaviour change initiatives (e.g., engagement of celebrities as ambassadors, mass media audio/video campaigns, swachhata selfie, on-ground citizen activation, etc.); and
- Continuous capacity building of ULBs through dissemination of technical advisories, providing need-based handholding support, classroom- and field visit-based workshops, etc.

The Way Forward

Urban India is now poised at a crucial juncture. While the sanitation situation in cities and towns has definitely improved, there is still a lot that remains to be done, so that all cities become truly smart and liveable. For example, while sufficient toilets (both for individual households and community/public toilets) have been constructed and people have started using them instead of going out for defecation, the issue of maintenance of the community/public toilets needs to be strengthened further

MoHUA has partnered with Google to upload and make available on Google maps all the public and community toilets in the cities so that citizens and visitors are able to easily locate these facilities in their vicinity. Till date, 58,000 public toilets (including 500 from NHAI) across 2,500 cities are visible on Google maps.

to ensure that the toilets do not fall into disuse. Similarly, the issues of safe containment, transportation and disposal of faecal sludge and septage from toilets, as also the grey and black water from households and establishments need to be strengthened further if the health impacts of holistic sanitation are to be realised. This is especially true for smaller cities without sewer networks, and for 60% households in the country that are dependent on on-site sanitation facilities such as septic tanks, which are more often than not constructed without soak pits, and where de-sludging trucks routinely empty the collected, untreated faecal sludge into open fields and water bodies. This implies that the health and other beneficial impacts of holistic sanitation are not likely to be achieved in the cities, despite being ODF.

The achievements in urban sanitation are still tenuous and likely to slip back if not sustained for the long term. At the same time, with the increased focus on 'swachhata', people's aspirations have gone up: citizens are now demanding higher quality of service and higher levels of 'swachhata'. Hence, the gains made till date need to be sustained and carried forward, by channelising the momentum created around the concept of 'swachhata'.

The various Missions under MoHUA have demonstrated a sustainable model of development in urban sanitation. Going forward, the focus will be on institutionalising the concept of swachhata, so that the holistic impacts from safe sanitation are achieved in line with our SDG commitments.

In this backdrop, the next steps in urban sanitation would be on sustaining the sanitation outcomes achieved and the momentum generated and taking Urban India to the next level of 'swachhata'. Also, the ecosystem around sanitation will have to be strengthened further to cement the

SWACHHATA SE SAMPANNATA		
SUSTAINABLE SANITATION	Complete Faecal Sludge Management	<ul style="list-style-type: none"> * Facilities for safe containment and disposal of all faecal sludge (creating all cities ODF++) * Adequate numbers of desludging vehicles
	Preventing hazardous / manual entry into sewers & septic tanks	<ul style="list-style-type: none"> * Protective gear, mechanical equipment for sewer/ septic tank cleaning * Setting up of Emergency Response Sanitation Units (ERSU) and Responsible Sanitation Authority (RSA) in all major cities
WASTE WATER TREATMENT	Treatment and reuse of waste water in cities	Treatment of all waste water before discharging into water bodies and their maximum possible reuse

Figure 6: Way Forward for Sanitation

sustainability of outcomes. Hence, we will now need to focus on the following areas in the coming months and years (Figure 6):

- Sustainable Sanitation (creating all cities ODF++ with complete FSSM solutions) and
- Waste water treatment (as per Water+ protocol of MoHUA).

All of the above will need to be planned and implemented under the overarching principle of 'Swachhata se Sampannata.'

Additionally, an enabling environment would need to be created through conducive policy support and reforms,

leveraging technology for Mission implementation, robust and real-time, data-driven monitoring supported by third-party verifications, capacity building of municipal staff, and private sector participation. We will need to think out-of-the-box and come up with even more innovative and 'smart' approaches such as incentivising cities through result-based funding, strengthening digital enablement of Mission governance, and setting up of a National Institute of Excellence to address all issues in Solid and Liquid Waste Management, on similar lines as other international and national institutes.

Conclusion

Today, the concepts of cleanliness and swachhata have come to embody the spirit of empowerment and quality of life. Progress in urban sanitation has already started impacting our lives and the larger environment positively. Our continued efforts in a sustained manner would lead to a 'Swachh, Swasth, Samarth, and Sashakt' New India. □

Endnotes

1. PHFI. (2015). India Health Report-Nutrition 2015. PHFI. Accessed from http://www.transformnutrition.org/wp-content/uploads/sites/3/2015/12/INDIA-HEALTH-REPORT-NUTRITION_2015_for-Web.pdf
2. https://mdws.gov.in/sites/default/files/UNICEF_Economic_impact_study.pdf

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Water Management: Building a Resilient Nation

UNICEF WASH Team

While the country has been declared to be free from the practice of open defecation, it is pertinent to continue looking at the necessity for faecal sludge and septage management, without which the quality and safety of drinking water may be affected negatively. It is important that Governments at all levels work together with local leaders and representatives who rise to become champions of the cause, so that resources can be synergised to gain the maximal outputs.

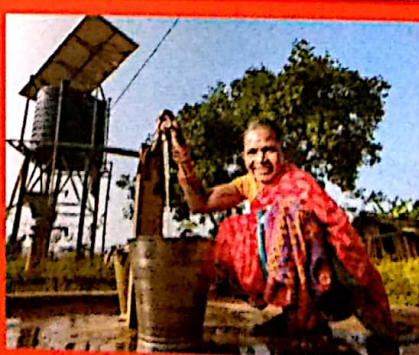
Life in this world is diverse and unique but what we all have in common is that we live and breathe on the same world, together. Our collective actions therefore impact our shared environment, which has shown to contribute towards negative outcomes such as increasing frequencies of climate change-related weather patterns and lower quality of environmental health. This in turn has related socio-economic costs to human society. According to a UKAID assessment in 2017, India had lost an average of USD 170 billion annually over the ten-year period due to weather and other environment-related causes.

In large part due to drastic environmental shifts, the variability in rainfall in certain regions of India has contributed to more and more drought-prone conditions. At present, approximately one-third of the country is either drought prone or under desert areas.¹ This has increased the vulnerability of communities dependent on agriculture and demands on the local water sources leading to resource mismanagement and geological distress. Subsequently, water is contaminated from over-exploitation, and the situation is compounded when communities lack necessary knowledge, infrastructure, and services to maintain environmental health standards related to water safety planning.

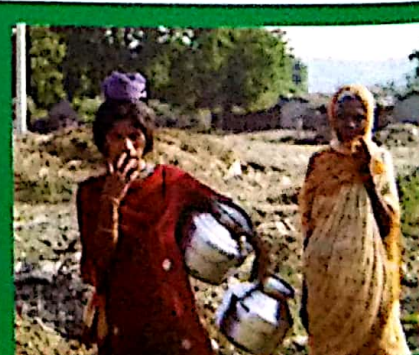
UNICEF is a key technical partner to the Government of India on water and sanitation programming and is dedicated to supporting the nation's progress towards Sustainable Development Goal 6 – universal access to safely managed water and sanitation by 2030. It is working with everyone from the Government to local communities to roll-out initiatives and frameworks that would tackle various challenges in the spectrum of the stresses on our water sources.



Environment and Community:
How Maharashtra is investing in women's leadership for sustainable development in water-stressed areas



Environment and Governance: The Story of Fluorosis Mitigation in Rajasthan



Environment and Intersectionality: Impact of Water and Sanitation Policies on Environmental Health in India

Environment and Community: How Maharashtra is investing in women's leadership for sustainable development in water-stressed areas

Maharashtra has declared drought in three of the past five years. Almost 70% of the State's geographical area lies in semi-arid region, rendering it vulnerable to water scarcity; this is exacerbated by further drought.² These impacted areas therefore experience wide year-to-year fluctuations in agricultural production and incomes and have a relatively high incidence of poverty, leading to them being left behind and experience poor agricultural yield.

UNICEF Maharashtra, with the support of the State's Disaster Management, Relief and Rehabilitation Department in 2015-16, carried out a rapid assessment to measure the impact of current drought and drought-like situations and the related consequences and coping mechanisms for communities, particularly children and women, in the Marathwada region. It was found that almost half of the villages had only one source of water for drinking and other domestic purposes, 27% of the farmers did not have any water management technique, and that during lean periods of the year, 84% of the families faced irrigation challenges. Women were disproportionately affected by water scarcity. This has tripled the burden of women and girls in terms of household tasks and they travel further to fetch water, fuel, fodder, and find casual work. This in turn worsens their sanitation, hygiene, and nutritional outcomes – all of which come with alarming multi-generational implications.

Overall, the lack of community-level management posed challenges for curbing exploitation and maladministration. Therefore, UNICEF along with implementation partners worked with the Government of Maharashtra to implement a pilot addressing resilience within the affected communities against these very issues.

'Women-led Water, Sanitation, Hygiene and Resilient Practices Project' or W-SHARP was implemented in 2018 to test the effectiveness of risk-informed planning driven by local contexts and communities such as those of Marathwada, especially during lean periods, March to June, when water availability is at an all-time low.

The pilot sought to enhance water, livelihood, and food security across 100 villages encompassing 10,000 families in two drought-prone blocks of Maharashtra. To build climate resilient practices within the most vulnerable groups, W-SHARP targeted women's and vulnerable families' participation as a core aspect of the project. The project took an innovative approach by positioning women as key change agents who charged forward in mobilising their communities, local bodies, and government

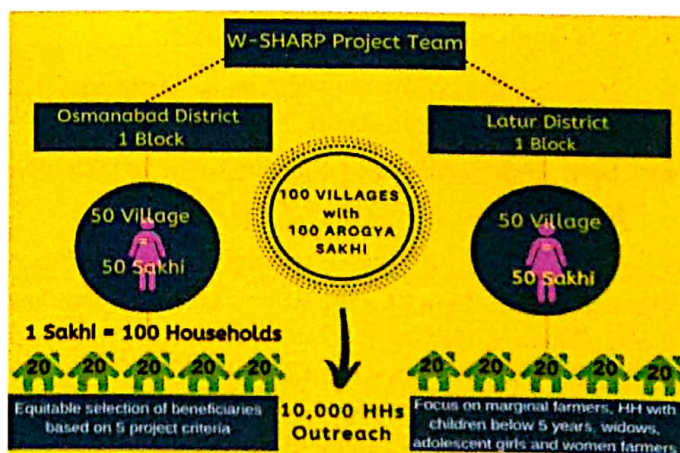
institutions for shared causes. It ultimately provided an enabling environment for marginalised women to learn coping strategies for the multitude of increasing uncertainties.

How W-SHARP Worked?

Fifty villages from each of the two blocks were selected based on the communities' existing vulnerabilities and involvement of women in local governance. To ensure inclusivity, 100 most vulnerable households from each target villages were involved. This included homes of marginal farmers and households headed by women and landless labourers. Attention was also given to families with adolescent girls or children below five years of age, to promote the passing of livelihood and nutritional benefits from heads of households to their children. Overall, 10,000 households were included in the project.

The project integrated the question of sustainability and gender empowerment in all its various approaches. Women community leaders, 'Arogya Sakhis' (*health friends*), were selected and trained by UNICEF and the implementation partner to promote hygiene, water security, and climate-resilient agricultural practices. This task force of community leaders was established in each village and was responsible for actively engaging with residents to raise awareness and knowledge of pertinent issues. Through the cascade training model, the 100 Sakhis trained other women and by the end of the project, over 500 women were collaborating with school and *anganwadi* workers as well as village-level leaders to promote water governance and nutrition-sensitive farming.

One key outcome of this project was to encourage community participation in local governance and foster partnership with relevant government and civil society institutions. This allowed W-SHARP to provide spaces for peer learning exchanges and dialogue fora. Trainings have been organised for community leaders to ensure



that community uniformity and last-mile connectivity is achieved through community tracking and monitoring systems of community behaviour changes through a 7-star tool and increased convergence with service providers such as ASHAs and *anganwadi* workers. The effectiveness of these efforts increased awareness and implementation of water conservation practices and sustainable management.

Key Interventions

Household-level Engagement: The Arogya Sakhis mobilised women's groups in their villages to discuss information and practices relevant to good water management practices at the household level. Women learned about and practiced reusing waste water, water budgeting, adopting groundwater management via soak pits, and other water-saving techniques.

Water budgeting involves understanding a household's overall water requirement based on the number of family members, major areas of consumption, and identifying areas for potential reuse for water. It is a simple yet effective tool that allows households to concretely appreciate utilisation of their resources.

Water budgeting was practised by all targeted households;

- All public water sources were included in the **sanitation surveillance plans**;
- **1,392 soak pits** were constructed in total across all targeted villages to capture grey water for reuse; and
- **28 group handwashing stations** were set up in various schools across the two blocks.

Community-level Engagement: Communities were engaged in discussions on climate-resilient practices and options for livelihoods. This includes adaptive sustainable practices; conscious shift to bio fertilisers; improving soil health, biodiversity conservation, and water efficient technologies etc.

- Community leaders and 2000 women farmers were trained on resilient practices;
- 1735 women farmers are presently practising mixed crop farming;
- 124 vermicompost beds were installed;
- 2650 families cultivating less water-intensive fodder and practice water allocation for livestock;
- 1470 families cultivated kitchen garden for themselves to encourage nutrition-rich diets.

Community Snapshot : In one village, community volunteers visited approximately 80 families to accumulate Rs. 2,000 and create a shared borewell. Four containers of drinking water were allocated per family, with minimal cost per litre. Drinking water was stored separately from that for domestic needs; communities were oriented to obtain the latter from nearby surface water sources. Three hundred women participated in digging up 120,000 sq m of trenches, which connected village areas to farms to encourage water storage and groundwater recharge.

Convergent Governance: A unique aspect of this project was the use of National flagship programmes to empower the communities. Construction of soak pits, toilets and adoption of new agricultural innovations were done through convergent funds. Swachh Bharat Mission-Gramin (SBM-G), Mahatma Gandhi National Rural Employment Guarantee Act and ATMA (Agricultural Technology and Management Agency) funds jointly provided access to Rs. 6,35,00,000.

100 Resilient Villages 100 Steps towards Sustainability

W-SHARP was designed in alignment with the Swachh Bharat Mission and Jal Shakti Abhiyan, both of which support protecting environmental resources through community-led practices. The Government will continue to observe the progress in these villages to assess the potential for scale-up to the rest of the region. The future of this programme will continue to focus on addressing the correlation between water, energy, land, and food and seek opportunities to integrate these lessons into the newer Jal Jeevan Mission and Integrated Watershed Management initiative. These efforts will localise the ambitions of SDG 6 and sustain the gain of sanitation access by completing the ecological loop.

W-SHARP aimed to sustain "*A gender responsive and resilient community with food and water security in drought prone areas*". Rightfully so, its biggest achievement was the emergence of women leaders. Many of the accepted interventions have been introduced through women as the change makers – women who are at the forefront of facing climate variability in their daily lives – who tackled challenges head-on and redesigned what sustainable practices means to their communities. W-SHARP has proven that a small step has been taken towards this goal, and these steps taken together lead to a healthier, stronger, and more resilient community.

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Environment and Governance: The Story of Fluorosis Mitigation in Rajasthan

The State of Rajasthan makes for a classic case on the socio-cultural and environmental implications of sourcing safe drinking water in a semi-arid and water scarce region. The State's population is heavily dependent on groundwater for its agricultural and drinking requirements in large part due to the absence of perennial rivers, inadequate surface sources, and arid climatic conditions. In addition, traditional sources such as stepwells were closed for stopping the spread of guinea worms and thereby limiting access of water. In remote areas, this translated to digging through ground for groundwater sources for creating numerous tube wells and handpumps, especially in the most remote areas of the State.

Thus, over-exploitation of the groundwater, which has increased due to recent climatic changes, along with recurrent droughts have contributed to the leaching of rocks with fluoride compounds, thereby releasing the volatile element into the water sources, making it unsafe for drinking. This has over time posed a dual challenge for the management of water resources: maintaining availability and quality of drinking water. As of December 2019, of a total 7,752 fluoride-affected habitations across the country, 3,748 of them (50%) are from Rajasthan.³ Drinking water with fluoride levels above WHO-prescribed limit of 1.5 ppm for prolonged period can lead to fluorosis, especially

in children. Dental, skeletal, and non-skeletal fluorosis, each with rising severity in succession, are irreversible diseases that severely affect joint movements, cause incredible pain, and often lead to the afflicted living in vegetative states. Achieving SDG 6 targets would require addressing environmental health fallout such as this to be prioritised by the Government and solved urgently.

Despite different mitigation initiatives with huge financial implications, people in affected areas are still at risk, in part because the efforts were usually limited to defluoridation of water without any consideration for related aspects. On the contrary, mitigation approaches need to start with better understanding of health impacts of excessive fluoride intake.

The current government initiative is taking past lessons into account and implementing a comprehensive multi-sectoral approach through the Integrated Fluorosis Mitigation (IFM) effort, introduced initially by National Environmental Engineering Research Institute (NEERI) and UNICEF in Madhya Pradesh in 2007 and later replicated in few other districts and States including Rajasthan. Even though IFM approach was conceived and piloted in Dhar and Jabua district of MP with respectable success in reversing fluorosis rates in children, it lacked crucial Government buy-in at the time. Subsequent replication



in Telangana and Rajasthan however continued to successfully demonstrate the positive impact of convergent governance models owned by State departments, and thus have positioned themselves as strong advocacy tools for similar approaches elsewhere and for other sectoral issues.

History of Mitigation Efforts

Since excess fluoride found in drinking water in 2001, there has been slew of mitigation measures by Public Health Engineering Department (PHED), and with support from UNICEF, culminating in the launch of 'Rajasthan Integrated Fluorosis Management Programme (RIFMP)' in 2004. In RIFMP phases I and II, domestic de-fluoridation units (DDFUs) based on adsorption technology were distributed through NGOs, who were supposed to educate people and train them in using the DDFUs. Despite high resource investment, both phases could not bring the desired success except for increased awareness in almost all the rural areas of Rajasthan. Based on lessons garnered from phases I and II, the Government launched phase III wherein the hand pump and tube well attached to large size DFUs have been installed through private agencies, that would operate and maintain the units for 10 years. Intensive complementary awareness campaigns to educate populations in the dangers of ingesting high fluoride levels are also to be conducted. Under the Government-supported National Rural Drinking Water Programme (NRDWP) programme, rainwater harvesting and ground water recharge initiatives were also taken up in a big way to provide alternative drinking water sources. Using rainwater for drinking however could not gain popularity in most of the districts, due to contrary socio-cultural preferences among the people. In its vision, the Government of Rajasthan aims to cover the entire state through surface water, but the treatment of ground water is likely to continue as an interim measure till the time piped water supply systems have been adequately established, aiming to achieve SDG 6 on ensuring access to safely managed water to the State's population.

Continued Challenges

The problem of fluorosis in Rajasthan has been quite complex and continues to affect more and more people with time. The shifting of people from their earlier wisdom of traditional water sources to piped water supply although takes care of water security, the question remains for source reliability, inability to monitor large-scale networks, and identification of safe reliable sources. Not being able to provide sustainable operation and maintenance of treatment plants through PRIs makes it even tougher. The present practice of indiscriminate supply of defluoridated water to the community living in an endemic area may not relieve those who are afflicted with fluorosis, as the fluoride entry

to the body may be much more from the sources other than drinking water. Improvement in drinking water supply in the endemic village of Rajasthan has decreased the burden of fluorosis, but low level of awareness and prevailing dietary and behavioural practices still expose them to risk of high fluoride intake. This needs to be studied for strategising efforts to combat the environmental fury of fluorosis holistically. There are critical gaps about the accountability of dealing with fluorosis, convergence, coordination, empathy, and will of the duty bearers to help the fluorosis-affected people getting rid of the menace.

The Present and Way Forward

Fluorosis cannot be mitigated by only providing fluoride-free water but must be integrated with health and nutrition-sensitive initiatives for holistic mitigation of menace of fluorosis. Hence all stakeholders need a convergent platform for eradicating fluorosis. Departments, in their plan, should focus on community participation and climate resilient water safety and security as part of this effort.

In Rajasthan, UNICEF supported the Government of Rajasthan in demonstration of Integrated Fluorosis Mitigation Approach pilot in Dungarpur in 2018, which is a people-centric district platform, led by District Magistrate to have focus on holistic fluorosis mitigation while leveraging programme funds across districts to support the planned activities. This model puts the District Magistrate in the leadership position and leverages the existing influence and responsibilities built into the Magistrate's position to prioritize fluorosis efforts within all relevant departments. On successful demonstration of the new model of integrated Fluorosis Mitigation Approach in Dungarpur district, which focuses on converging the efforts of multiple state and district departments to reduce fluorosis and realising positive outcomes through it, the Government of Rajasthan has agreed to scale up the new approach to RIFM in all affected districts, in a phased manner, within a timeframe of four years. The approach has, along with water, health, and nutrition-sensitive initiatives, high possibility of achieving reversal of fluorosis, especially in (0-12) age group children.

To protect environment, identification and promotion of reuse of water and recharging of aquifers and sources for creating a balance between discharge and recharge of water are needed. It will also help in maintaining the quality of water in the source. The recent Jal Shakti Abhiyan is a great initiative by the Government, which had shown good intent by converging all the line departments on a common platform of the integrated approach in water management.

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Environment and Intersectionality: Impact of Water and Sanitation Policies on Environmental Health in India

While safe drinking water as part of environmental health has long been realised as critical to healthy life, improved sanitation facility in India has, of late, been recognised as essential for provisioning safe drinking water. This is because people get exposed to faecal transmitted infections (FTI) through exposure to faecal matter in their environments, which can result from open defecation and poorly constructed toilets. Approximately 88% of diarrheal deaths in children can be attributed to unsafe water supply, inadequate sanitation, and hygiene behaviour.⁴ In 2017, WHO estimated that 525,000 children under five died due to diarrheal disease, globally, out of which 117,000 children under five died in India.⁵ Therefore, environmental health and resilience are only as good as the investment in sustainable and effective sanitation and safe water provisions.

The systems for solid and liquid waste management, including faecal sludge management and drainage, are important for better prevention of faecal contamination in the environment.⁶ This is in line with SDG 6, for which attaining safely managed water and sanitation requires policies that invest more on frameworks seeking to go beyond simply providing toilets and water supply; they must encourage community and individual ownership over the results to ensure positive, long-term outcomes.

Policies on Water Supply and Sanitation

2019 has been a significant year for the rural water supply and sanitation movement. The launch of the 2019-29 National Rural Sanitation Strategy post Swachh Bharat Mission's 2 October deadline, Jal Jeevan Mission, and the Revised Uniform Water Quality Monitoring Protocol are not stand-alone policy decisions but parts of a well-thought out holistic and integrated strategy to provide universal access and promote inclusion of last-mile populations. If these policies can be implemented convergently while incorporating the recommendations below, they have great potential for positively impacting resource management practices and the status of environment health.

Investing in Retrofitting and Waste Management:

Since the launch of SBM-G in 2014, over 10 crore toilets have been built in rural areas; over 5.9 lakh villages, 699 districts, and 35 States and Union Territories have declared themselves ODF.⁷ The 10 Year Rural Sanitation Strategy (2019-29) aims to achieve the vision of ODF-Plus, which focuses on sustaining behaviour change achieved under SBM-G, universal usage of sanitation facilities, inclusion of new households, as well as effective solid and liquid waste disposal.

The type of toilets constructed in the entire sanitation programming in India is mainly of three categories: single leach pit, twin leach pit, and septic tanks. Single pits need retrofitting-- either converting it into twin pits with consideration of space, so that the human excreta over the time degrade completely and turn to solid pathogen-free manure for agricultural use or making provisions to empty the pit periodically.

Similarly, the effluent from septic tank, under no circumstances, should be allowed into an open channel drain or body of water without treatment. Experience from the field says that majority of septic tank designs are faulty which are used as holding tanks of sewage--the liquid waste of household and community including human excreta. Some septic tanks are found to be connected to open drains, agricultural fields, country-yard, and rivers. These contaminate water, soil, and some agricultural products which is detrimental to health. As per the Indian standard code for installation of septic tank, the unsatisfactory design, construction, and maintenance of septic tanks constitute health hazard.

It is therefore considered essential to lay down minimum standards for guidance of concerned authorities.⁸ At this junction of ODF plus initiatives, both single leach pit toilets and septic tanks would be challenging as far as faecal sludge and septage management (FSSM) is concerned. Programmes with special focus on toilet retrofitting and more of managing the substructure of toilet units both at household and community level are needed. Proper septic tanks offer a preliminary treatment of sewage prior to final disposal which restricts damaging the environment by protecting water sources and soil.

Formation of Jal Jeevan Mission (JJM) and Provisioning Pipe Water Supply (PWS) to all Households: Ministry of Jal Shakti issued Jal Jeevan Guidance Note in March 2019, which informs that only



18.33% (3.27 crore) of rural households in the country are connected through piped water supply (PWS). The present estimate being discussed is around 14.60 crore rural households that will need functional household tap connection (FHTC) at the rate of 55 litres per capita per day (lpcd) through JJM by 2024.

This ambitious target setting of 100 per cent coverage of functional household tap connections (FHTC) from the current 18% demands the rise of an adequate and proportional pool of skilled human resources, institutional strengthening, strategic planning, consistent monitoring including on-site field verification, supportive supervision, and participation of community members at local level. Some of the key supplementary activities like completion and retrofitting of existing PWS schemes to provide FHTC; to raise the service level from 40 lpcd to 55 lpcd; augmentation of existing source; reliable drinking water source development; grey water management; and integrated water resource management would be as vital as the prime work for the implementing agencies.

Standardising Water Quality Testing and Monitoring: Water quality testing is a tool that is universally used to identify safe drinking water, whether at source, within a piped distribution system, or at point of use by consumers. As per WHO, the most effective means of consistently ensuring the safety of a drinking-water supply is using a comprehensive risk assessment and risk management approach that encompasses all steps in water supply from catchment to consumer.⁹ Considering the importance of ensuring safe drinking water, the erstwhile Ministry of Drinking Water and Sanitation published the revised Uniform Drinking Water Quality Monitoring Protocol in March 2019. The protocol is suggestive in nature and plays an advisory role in guiding and supporting the States and Union Territories in water quality testing, monitoring, and surveillance activities effectively.¹⁰ The protocols speaks in details on the monitoring of water quality using field test kit at the gram panchayat level and confirmation test at water testing laboratories and water quality surveillance, to detect the risk through an investigative activity for identifying and evaluating the factors that can pose risk to health directly or through undesirable environmental conditions.

Conclusion

While the country has been declared to be free from the practice of open defecation, it is pertinent to continue looking at the necessity for faecal sludge and septage management, without which the quality and safety of drinking water may be affected negatively. Concurrently,

it is also important to look at the possible challenges posed by intermittent water supply and the interaction between pipes and their external surroundings due to flux in water pressure.

Overall, to ensure the success of Jal Jeevan Mission or any other programmes catering to rural communities, it is crucial to involve gram panchayats and village water and sanitation committees in the decision-making processes. This will ensure ownership over and sustainability of any achievements made over the coming years, and once communities can tangibly appreciate the value of a functioning system, they would be more willing to invest in operations and maintenance efforts that will be necessary down the line. Therefore, it is important that Governments at all levels work together with local leaders and representatives who rise to become champions of the cause, so that resources can be synergised to gain the maximal outputs. □

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Role of Community Radio in Disaster Management and Climate-change Communication

Nuti Namita

Community radio specialises in providing local information to the local people. Thus, it can play an important role in disaster risk reduction, especially in pre-disaster preparedness and mitigation through awareness raising that targets different community groups. The Ministry of Information & Broadcasting, Government of India is committed to develop a vibrant Community Radio movement through participation, involvement and ownership of the local community for greater information dissemination and further empowerment of people.

Community Radio in India

Community Radio provides an opportunity to the community to speak about issues concerning their lives. In December 2002, the Government released a policy that allowed well-established educational institutions to set up Community Radio Stations. In order to promote development and social change, the Government in November 2006 implemented new Community Radio Guidelines permitting non-profit organisations to own and operate community radio stations. With the new policy in place, it opened doors for community radio as a platform for development, social change, and voice of the community in concern.

At present, 276 functional Community Radio Stations are operating in India. Out of these 276 stations, 129 are run by educational institutions, 132 by community-based organisations, and 15 by Krishi Vigyan Kendra/State Agriculture Institutions. At present there are 78 coastal districts in the country. However, all coastal districts do not have operational

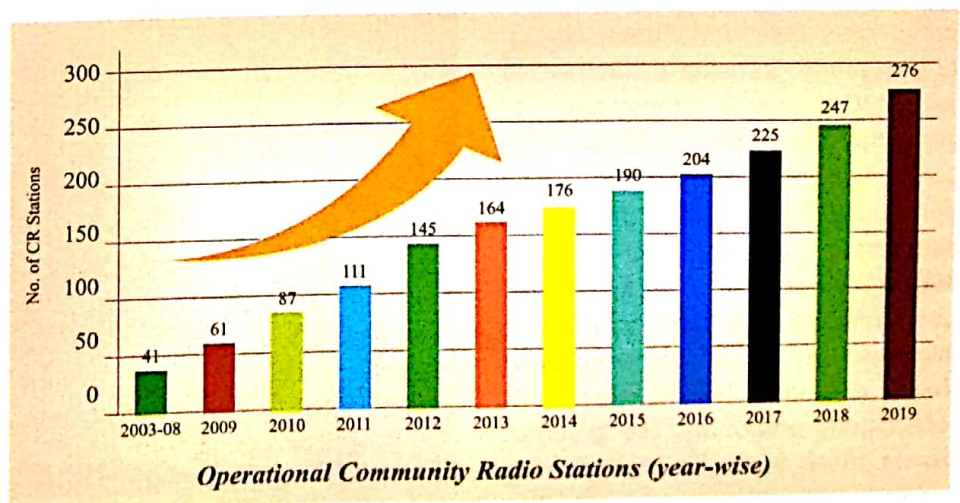
community radio stations. There are 51 operational community radio stations in 26 districts. Community radios are also prominently being used in Nepal, Bangladesh, and Philippines for rural development. They are equally popular in Canada, America, Australia, and South Africa.

Community Radio is useful in:

- Speaking to communities in local languages using terms and phrases that are easily and locally understood;
- Providing two-way interactive

social learning through listening clubs, call-in shows, and other forms of exchange;

- Communicating local knowledge, needs, and demands beyond the community to inform policy, research, and other communities;
- Providing the only media available to communities that have little or no access to other methods of conveying information and knowledge;
- Bringing together people from frequently disconnected



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- stakeholder groups such as livelihoods, community leaders, organisations and governance.

Community Radio and Disaster Management

The presence of community radio in every phase of a disaster-disaster mitigation, preparation, early warning, response, recovery and revitalisation, is essential for the exchange and sharing of information and dialogue among residents as well as the enhancement of the community's capability and of self-governance ability. Stories about climate and environmental change appear in the form of documentaries, interactive talk shows, drama and

At present, 276 functional Community Radio Stations are operating in India. Out of these 276 stations, 129 are run by educational institutions, 132 by community-based organisations, and 15 by Krishi Vigyan Kendra/State Agriculture Institutions.

music, etc. helping communities to learn more about these impacts and share their experiences of responding to them.

Most initiatives linking community radio and climate change are currently focusing on delivering information and messages to listeners about short- and medium-term forecasts, for farmers, alerts for extreme weather events, and messaging to discourage practices which degrades environmental assets. While these remain important messages for communicating local climate change adaptation, community radio has the potential to do much more by strengthening community voices and providing an accessible space for knowledge



Emergency Radio, Cuddalore, Tamil Nadu

sharing between communities. Thus, the sense of empowerment that people and communities can feel by engaging in this way can help to build local, institutional, and organisational capacity.

Scope

Community radio can play a crucial role in disaster management via assisting the community in three stages:

Pre-Disaster

In the pre-disaster stage, community radio stations can provide guidance regarding its preparedness. Information regarding gathering

locations and safety shelters can be disseminated. Programmes regarding sanitation measures and first aid practices can be broadcast. Also, safety drills can be organised, educating people about emergency plans and responses. Another important task is broadcasting warning signals in case there is a calamity foreseen or likely to occur. Community radio holds such potential since it can reach areas and people that cannot be reached by other forms of communication. It breaks the barriers of literacy and economic status in bringing people together in times of disaster.

While television networks



Community radio journalists are helping farmers access climate science and share adaptation techniques in Madhya Pradesh

break down almost instantly in face of natural disasters, radio carries with it the potential for continued functioning in such times. It can foster community's awareness on the current situation in other places hit by disaster; announce forecast, and warnings issued by the meteorological department and provide updates on the status of relief and rehabilitation operations.

During Disaster

At the time of a disaster, most forms of communication are disrupted barring radio signals. Community radio can help the community link with

safety shelters where they can access aid and rescue facilities. Locals can call in and provide first hand information regarding the on goings in the affected areas.

Post Disaster

This is a very crucial phase as during rehabilitation the community requires maximum support. Having a medium of communication in their own language or dialect can help in the strengthening the morale of the community. Post-trauma counselling and updates on relief and aid can be a part of the content being broadcasted. Guidelines regarding disposal of

to make use of community radio approach.

Training Community Radio Staff in Disaster Management

For effective utilisation of community radio in disaster management, it is essential that the staff members should be trained in a specific and well-defined manner on disaster prevention, mitigation, and management communication. Several Government departments/Ministries at central and state level working on climate change and disaster management can join hands together to use this platform.

Conclusion

Rural areas are constantly faced with natural calamities given



the relief agencies and Government control room. Two prime advantages of community radio are that they focus to the affected communities and the content is delivered in the local language. This can help in disseminating rescue operation information by location-specific stations. Also, since the information is in the local language/dialect it helps avoid any miscommunication. Information and announcements regarding vulnerable areas which require immediate evacuation can be broadcasted and the community members can be guided to

wastage, restoration of safe water supply and basic sanitation can be provided. Community radio provides an indigenous solution to a problem that is being faced at a large scale in the country these days. It can be an important component of rescue, relief, and rehabilitation efforts. The need is to build the capacity of operating personnel of community radio and equip them to handle and disseminate disaster-related information in an optimal manner. In this manner, the local community itself can be enabled through infrastructure and training

The presence of community radio in every phase of a disaster--disaster mitigation, preparation, early warning, response, recovery and revitalisation, is essential for the exchange and sharing of information and dialogue among residents as well as the enhancement of the community's capability and of self-governance ability.

the environmental change. During forest fires in summer, landslides in monsoon, etc. these communities constantly struggle and their isolated situation doesn't help the cause. Community radio has the power to organise and provide information and connect these communities to the much needed aid and relief. Also since the content is in the local dialect it can help curb miscommunication and misinformation in times of panic. Several initiatives and innovations are happening in the community radio front but they can serve their purpose best if integrated together. □

In Conversation with Prof. M.S. Swaminathan

Monkombu Sambasivan Swaminathan, popularly known as Prof. M.S. Swaminathan, father of the Green Revolution, greeted us with a smile when we met him at his office on a bright, sunny morning of 11 December, 2019. He fondly recollects his association with Yojana, when Sharada Prasad was at the helm of affairs as Yojana Editor in the early 60s. "Those years, there were very few issues of Yojana, where my article would not have appeared", Prof. Swaminathan says with pride. At the age of 94, the founder of M.S. Swaminathan Research Foundation (MSSRF), though tied to his wheelchair, but his mind is still sharp and is equally passionate about promoting sustainable agriculture, improving the standard of living of ordinary farmer, and offering suggestions on how to prepare ourselves to combat climate change.

Excerpts from Prof. Swaminathan's interview by Sanjay Ghosh, Yojana, Chennai.

The Prime Minister in his address at the United Nations Climate Change Summit has mentioned that behavioural change is the need of the hour to combat climate change. How do we bring about this change?

Behavioural change comes at three levels. One, from home, where the role of the mother is very important. Secondly, in schools and colleges. Thirdly the society, starting from political leaders, unless they have a commitment to ensure that we do not interfere with climate, we will have difficulty. Therefore, the behavioural changes have to be brought about at three levels. At home level as usual, the school and college level where education has an important role to play and finally your life and your attitude towards public life. In our country, unfortunately, we do not have yet well-organised programme of public education.

There is an effort. [The] Prime minister particularly tries his best to spread the news about the dangers of climate change. But, I would say, we do not yet have it in our schools,

colleges, and homes. In our own homes we still switch on air conditioners even when it is not needed. Now you should know every unit of energy we depend on is non-renewable energy, then we are in difficulty. So how do you promote renewable energy instead of non-renewable energy? In other words, there is a need for energy management at household levels, at institutional levels and in cities and towns. So, it requires a number of steps to create more public awareness at schools and colleges. I strongly believe every Panchayat should have a climate management society. We should try to educate the Panchayat members about the need to combat climate change.



The Government has rolled out several policies and programmes to tackle climate change. What more needs to be done?

We are very unique in one sense. We are a democratic society, secular democracy—a vibrant democracy at three levels—at the grassroot level, Panchayat institutions and at the State-level legislative committees and so on. In terms of life and public education at National level we also have large number of academies, scientific institutions, and a number of universities. At political level, starting from Gram Sabha to Parliament. And that is why I would say public education should become everybody's business. Not only a few, but we should all feel that the climate does not distinguish the rich and the poor man. All are equal before the climate. And only if you are rich you try to manage the climate in your own room by using energy. I think the time has come for us in our country, to come together to tackle climate change. We have started MSSRF climate research in the year 1989. Over thirty years we have taken a number of steps on this front.



Photo: Sanjay Ghosh

In the beginning there was very great reluctance. But things are changing. I think we are in the mode of transition from a high carbon society to a low carbon society. We should try to make use of this transition as far as possible, for the good of the country.

Is this transitional phase taking longer time?

That's true. That is what I said earlier. Theoretically, our people are aware of the climate problem. In fact, we were among the first to have had IMD, Indian Meteorological Department, for climate measurement because we are largely an agricultural country. Due to the whole photosynthesis, agriculture is main source of renewable energy. We know in South India, for example, they worship the Sun and the green plant during the Pongal time. The idea of the Sun being worshipped is the fact that the green plants are absorbing the sunlight and converting it into energy. These are all advance stage of knowledge. When I ask people what is the meaning of the Pongal? Why do they choose sugarcane as a variety? People don't know that. Sugarcane is the most efficient absorber of solar energy.

So, I think, we are making a transition now and with the Government, the present Government in particular is giving a lot of emphasis on climate issues. In the recent climate change conference [COP, Madrid], I hope it will come to an agreement with all countries. It is not India, it is not Eurasia, it is not USA but every citizen of this world should have a feeling that it is my planet. He should feel that this is the only one I have and therefore I should try to protect it

from climate change or other forms of changes.

I think the story is happening though I am not satisfied with the pace. But I am sure with the knowledge of today, there is a growing awareness that climate has tremendous influence upon the future of our lives and planet. It is not happening at the

pace which is needed largely because energy is important for everything. This room is now lit; it needs energy for that. For cooking we need energy. Therefore, the pace can be accelerated provided we find alternatives to every one of the high carbon activity. For example, the smokeless chulha—it may be a small item. But that's important. It will make a contribution. We should try to make more and more such contributions and we should be aware of the importance of climate change. In the next ten years nothing much is going to happen. But, next twenty years it will happen. By that time your children will be grown up and therefore we should not become complacent.

In the recent months stubble burning has become a major cause for pollution in Delhi. What are the steps that the Government needs to take to tackle it?

When the rice, wheat crop rotation began in Punjab, stubble burning started. I have been a witness to this from the beginning. Generally, rice varieties will grow long. But then

About Prof. M.S. Swaminathan

A plant geneticist by training, Professor Swaminathan's contributions to the agricultural renaissance of India have led to his being widely referred to as the scientific leader of the green revolution movement. He was described by the United Nations Environment Programme as "the Father of Economic Ecology" because of his leadership of the ever-green revolution movement in agriculture. He was the Director of the Indian Agricultural Research Institute (1961-72), Director General of Indian Council of Agricultural Research and Secretary to the Government of India, Department of Agricultural Research and Education (1972-79), Principal Secretary, Ministry of Agriculture (1979-80), Acting Deputy Chairman and later Member (Science and Agriculture), Planning Commission (1980-82) and Director General, International Rice Research Institute, the Philippines (1982-88).

Professor Swaminathan was awarded the Ramon Magsaysay Award for Community Leadership in 1971, the Albert Einstein World Science Award in 1986, the first World Food Prize in 1987, and Volvo, Tyler and UNEP Sasakawa Prize for Environment, the Indira Gandhi Prize for Peace, Disarmament and Development in 2000 and the Franklin D Roosevelt Four Freedoms Medal, the Mahatma Gandhi Prize of UNESCO in 2000 and the Lal Bahadur Sastri National Award (2007). He is the recipient of Padma Shri (1967), Padma Bhushan (1972) and Padma Vibushan (1989).

Source: <https://www.mssrf.org>

the rice has to be harvested. The rice has to be harvested by September/October so that wheat can be planted at the right time. Otherwise wheat yield will go down. Therefore, I have suggested we should have varieties of rice which can be harvested earlier. The longer the duration, they get good yield; but they don't go by the one crop yield. Take two crops together: the rice and wheat rotation.

Somehow, there is a completely new crop rotation now in Punjab. Wherever this rice, wheat rotation is in place we need a Rice Bio Park. Rice Bio Park means every part of the rice—the plant, straw, the hull, the husk, the leaves—all of them should be utilised. They all have uses. My point is unless there is an economic value to them, farmers will not adopt it. In South India, they don't burn straw. In my house we used to have four or five cows, so straw was very important and was used to feed the cows. My mother would not waste even one straw as there was an economic value to it. People look after it. Farmers resort to stubble burning when they don't have any economic value. Stubbles have so much value. I wrote to Government of Rajasthan stating that you are near Punjab, you have lot of cows which are undernourished. So why don't you buy all the stubbles from neighbouring Punjab, giving them money, taking them as feed to the cattle. Unfortunately, these are my views. Good ideas sometimes remain on paper. However, some of my good ideas were adopted very fast. But in this kind of change in cropping system we have to provide technology to the farmers in the fields to convert rice straw into useful end products.

But in this kind of change in cropping system we have to develop a technology. For example, in ancient times in Tamil Nadu, there were five major farming systems, namely, *Kurinji*, *Mullai*, *Marutham*, *Neithal*, *Paalai*. In the hill zone, forest zone, wet zone, the coastal zone and the

desert zone, each required different methods to be adopted for farming. But, I think that knowledge is now forthcoming. You see normally they blame the farmers. They are producers. We have become number one producer of rice in the world. Thailand used to be the number one. Therefore, there is no use in blame game. What is important is here is the rice stubble. It is a good source of calories for animals and also has good vitamins. How can farmer make use the untapped source for additional income? I did my best when I was in the International Rice Institute, Philippines. Mrs. Cory Aquino was the country's President. She came to the foundation, took a round at the rice bio park and she saw a beautiful rice straw paper. She asked, how much it costs? Can you make thousand Christmas cards this year out of rice straw paper? She placed the order.

If I have this rice straw and able to get to say Rs.1000 a ton which is not difficult, then I will not burn it. If you give to neighbouring Rajasthan it becomes the animal feed. It becomes a raw material for making paper, board, it becomes a re-manure method for improving soil fertility. Economic value will make the farmer stop stubble burning. So there are economic uses of stubble, but there is a need for proper dissemination of information on the economic value of stubble.

What would the government do to make the technology available to the farmers to stop stubble burning?

Unfortunately, in our country technology transfer is slow. Because we have agriculture as State subject and Government of India is concerned with larger issue, policy and so on. At the village level also there is no extension agencies. I started for this purpose what we call Krishi Vikas Kendras in 1972. I thought something like Krishi Vigyan Kendras. The idea has caught on but nevertheless we

require at least a climate management unit at every Panchayat, the issue of stubble burning can be added as an item in their climate management agenda.

Artificial intelligence and IoT are playing major role in every sector. How can we harness these technologies in agriculture?

Nationally it has to be done at three levels. One is we should have a National Academy which has branches all over the country just as the Indian Science Academy. Secondly, every Panchayat should have a method of doing. Thirdly, Government of India now has the annual meeting of all the Chief Ministers. There we should put up an agenda and say you should take it up as a method.

Today's food system is one of the main drivers of deforestation and bio diversity loss. How do we tackle it?

Well! For food system we require more land. Ideally a country should produce more and more food in less and less land. Try to maximise the productivity pathway than area expansion. Because our average yield is still 1 ton to 1.5 ton per hectare while in countries like Japan it is 5 ton to 6 tons per hectare. We can easily manage it by growing crops at higher productivity level. Also, we must include along with productivity, the quality of the grain, whether it is Basmati or any other variety, which you can export more. If you can export more you can grow more rice. We have largest rice cultivating area in the world—over 40 million hectares. So there is lot of scope to grow more rice, more wheat.

We are essentially an agriculture country. That's what we have to recognise. Modern industry is labour saving. Agriculture is labour absorbing. Jobless growth is not what we want. Job-led growth is needed and agriculture provides the solution. □

Mitigation of Carbon Footprint

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India has committed at the Paris Climate Change Agreement to reduce its emissions by 33-35% by 2030, which necessitates immediate implementation of carbon capture with afforestation of degraded landscapes with native species, regulations of land use land cover (LULC) changes and de-carbonisation through large-scale implementation of renewable and sustainable energy alternatives. This article studies in-depth on the issue taking a case of ecologically-sensitive Western Ghats region.

Global warming with the burgeoning anthropogenic greenhouse gas (GHG) emissions (400 parts per million from 280 ppm CO₂ emissions of pre-industrial era) has been altering the climate, eroding the ecosystem productivity and sustenance of water, thus affecting the livelihood of people. The anthropogenic activities such as burning fossil fuel, power generation, agriculture, industry, polluting water bodies, and urban activities are responsible for increasing GHG footprint of which 72% constitute CO₂. GHG footprint needs to be in balance with sequestration of carbon to sustain ecosystem functions. Forests are the major carbon sinks (about 45%) that aid in mitigating global warming.^{1,2}

The land use land cover (LULC) dynamics leading to deforestation and land degradation is the prime driver of global warming due to the loss of carbon sequestration potential as well as emissions. The Western Ghats (WG), Fig. 1 are one among 36 global

biodiversity hotspots and forests in this region sequestering atmospheric carbon, which aid in moderating the global climate. The region is endowed with 4,600+ species of flowering plants (38% endemics), 330 butterflies

(11% endemics), 156 reptiles (62% endemics), 508 birds (4% endemics), 120 mammals (12% endemics), 289 fishes (41% endemics), and 135 amphibians (75% endemics). It covers an area of approximately 160,000



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sq. km. It is considered as a water tower of India due to numerous streams originating and draining millions of hectares. The rivers of WG ensure water and food security of 245+ million people in the peninsular Indian States. The region has tropical evergreen forests, moist deciduous forests, scrub jungles, sholas, and savannas including the high rainfall savannas of which 10% of the forest area is under legal protection.

The land use (LU) dynamics was assessed using temporal remote sensing data of Landsat 8 Operational Land Imager (OLI-30 m resolution) 2018 data integrated with field estimations and decadal land use (1985, 1995, 2005-100m resolution) available from International Geosphere-Biosphere Programme (IGBP). The collateral data included the vegetation maps developed by French Institute of Puducherry, topographic maps (the Survey of India) and virtual earth data (Google Earth, Bhuvan). The carbon sequestration potential of forest ecosystems was assessed on (i) published literature based on the standard biomass experiments and (ii) field-based measurements collected across the forests of WG of Karnataka using transect-based quadrat sampling techniques.^{1,2}

The spatiotemporal LU analyses presented in Fig. 2, highlights the loss of forest cover due to anthropogenic pressure. The region had 16.21% evergreen forest cover in 1985, which is reduced to 11.3% in 2018. It has 17.92%, 37.53%, 4.88% under plantations, agriculture, mining and built-up, respectively. The increase in monoculture plantations such as acacia, eucalyptus, teak and rubber, developmental projects, and agriculture expansions are the major drivers of LU changes. The region has lost 12% of interior (contiguous) forest cover during 1985 to 2018 with an increase of non-forest cover (11%). The interior forests (25% in 2018) are confined to major protected areas; edge forests are becoming more prominent due to sustained anthropogenic pressure (Fig. 3). Goa has experienced loss of large tracts of interior forest cover due to the indiscriminate rampant mining activities. The projected LU of 2031 (Fig. 4) highlights likely loss of evergreen forest with increases in agriculture cover (39%) and built-up area (5%).¹ The large scale changes of agriculture and built-up cover are noticed as per Fig. 4, in the eastern Kerala, Tamil Nadu, and Maharashtra States of WG. The evergreen forest cover will only be 10% of the WG by 2031, which would threaten the sustenance of water and other natural resources,^{3,4} affecting the food security and livelihood of people in the peninsular India.

Carbon Sequestration

The carbon sequestration potential of WG has been quantified, which confirms that the forests of WG are incredible reservoirs of biomass and carbon stock,^{1,5,6} highlighting the critical role of forests in lowering atmospheric carbon (emitted due to anthropogenic

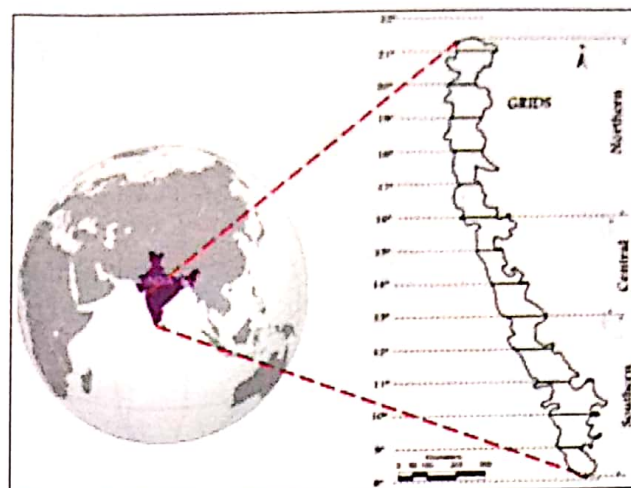


Fig. 1 Study Area-Western Ghats, India

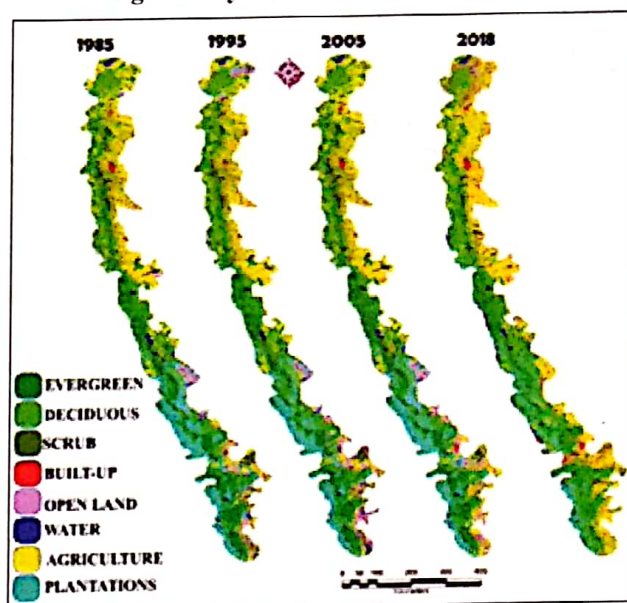


Fig. 2 LU Analyses of WG from 1985-2018

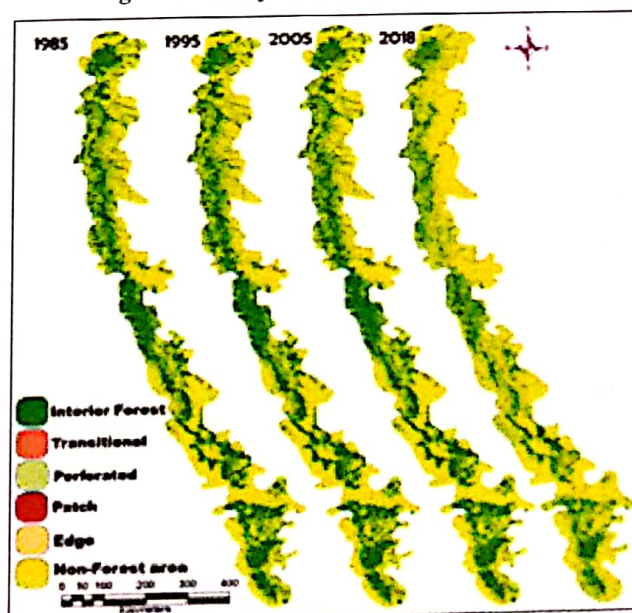


Fig. 3 Forest Fragmentation from 1985-2018

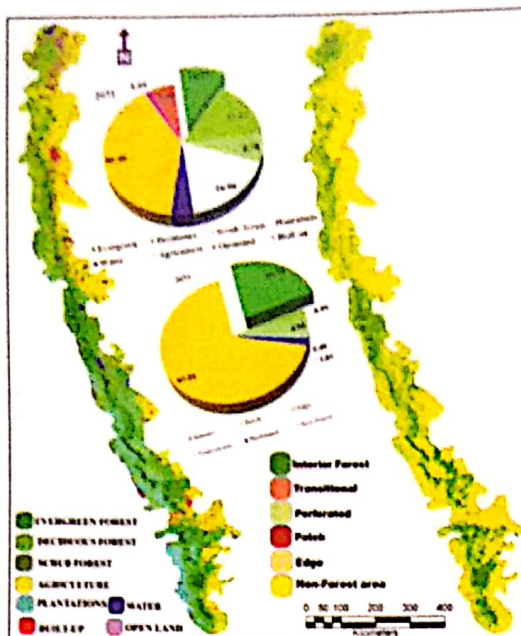


Fig. 4 Likely LU and Fragmentation of WG by 2031

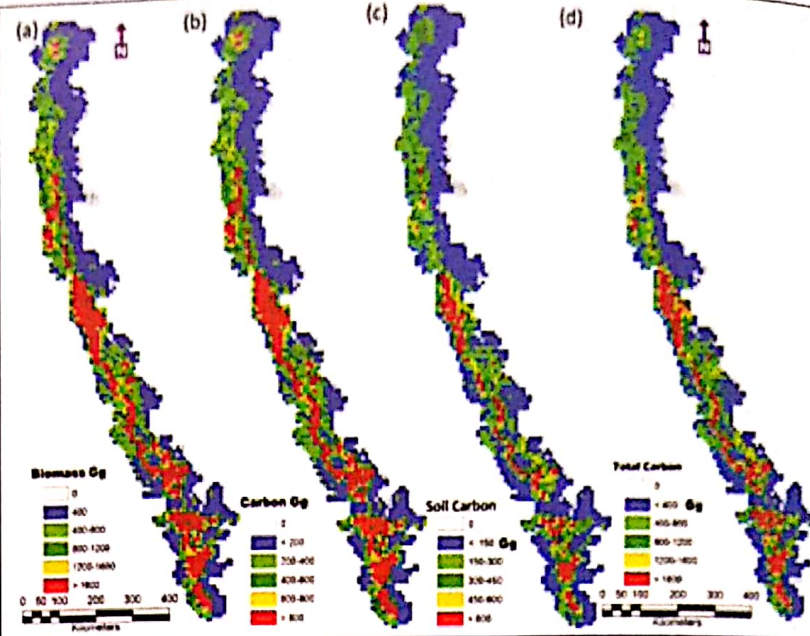


Fig. 5 Above Ground Biomass (Standing Biomass), Carbon, Soil Carbon Content and Total Carbon Stock of WG

activities) and mitigation of global warming (Fig 5a, 5b). The southern and central WG regions endowed with the rich native forests have soils rich in carbon (0.42 MGg), evident from Fig. 5c. Similar trend is noticed in the incremental carbon captured by soil 15120 Gg, and higher carbon content increment per year is noticed in Karnataka and Central Kerala parts of WG. The total incremental carbon excluding carbon loss through productivity is accounted to be 37507.3 Gg. The likely changes in carbon sequestration potential in the WG is estimated considering simulated

LU's (a) conservation scenario and (ii) business-as-usual scenario. The business-as usual-scenario (with the current trend of decline of forest cover due to LU changes) depicts the above ground biomass of 1.3 MGg with stored carbon of 0.65 MGg and soil carbon of 0.34 MGg.

Carbon Footprint

Carbon footprint is contributed by emissions from the energy sector (68%), agriculture (19.6%), industrial processes (6%), LU change (3.8%) and forestry (1.9%), respectively in India with CO₂ emissions of

about 3.1 MGg (2017) and the per capita CO₂ emissions of 2.56 metric tonnes. Carbon emissions from major metropolitan cities of India is about 1.3 MGg contributed by major cities such as Delhi (38633.20 Gg), Greater Mumbai (22783.08 Gg), Chennai (22090.55 Gg), Bengaluru (19796.6 Gg), Kolkata (14812.1 Gg), Hyderabad (13734.59 Gg), and Ahmedabad (6580.4 Gg) from energy, transportation, industrial sector, agriculture, livestock management and waste sectors per year.⁵

Ecologically fragile WG has been playing the pivotal role of mitigating

Table 1. Carbon Emission Across the States of WG

State/UT	Emission (Gg) per year			Total (Gg)	Carbon storage in WG (Gg) per year	% Removal
	CH ₄ (CO ₂ equivalent)	CO (CO ₂ equivalent)	CO ₂			
Goa	233	337	3881	4451	872	20
Gujarat	15546	14498	79138	109182	1947	2
Karnataka	15662	15239	54337	85237	10401	12
Kerala	3167	6108	26047	35321	7617	22
Maharashtra	23129	26497	105260	154886	11020	7
Tamil Nadu	15761	19190	71107	106058	5375	5
Dadra and Nagar Haveli	46	63	1458	1567	601	38
Total Emission (Gg)				496703	37833	8

carbon footprint with the potential to sequester carbon emission of all southern Indian cities and 1.62% of the total CO₂ emissions from India. The total emissions from WG states accounted to be 352922.3 Gg (Table 1) and forests of WG have the ability to sequester 11% of the emissions, which highlights vital carbon mitigation role and in moderating climate. India has committed at the Paris Climate Change Agreement to reduce its the emissions by 33-35% by 2030, which necessitates immediate implementation of carbon capture (with afforestation of degraded landscapes with native species, regulations of LULC changes) and de-carbonisation (through large-scale implementation of renewable and sustainable energy alternatives) through stringent norms towards (i) protection of ecologically fragile regions, (ii) dis-incentives for continued higher emissions based on 'polluter pays' principle, (iii) adoption of cluster-based decentralised developmental approaches, and (iv) incentives for reduced emission. The carbon trading has demonstrated the potential in monetary values across the globe of Indian forests in capturing carbon and the forest ecosystems in the WG are worth Rs. 100 billion (\$1.4 billion) at \$30 per tonne. The carbon

Catchment integrity plays a decisive role in sustaining water for the societal and ecological needs, which is evident from the occurrence of perennial streams in the catchment dominated by native flora, highlighting the riverscape dynamics with the hydrological, ecological, social, and environmental dimensions linkages and water sustainability.

credit mechanism and streamlining stakeholder's active participations would dramatically reduce the abuse of forests and encourage farmers to grow trees and converting the land to its next best use.¹⁻⁴

Water and Food Security towards Sustainable and Healthy Living

Ecologically fragile Western Ghats through perennial streams and rivers has been ensuring water and food security in the peninsular India. Alterations of landscape structure in the catchment areas influence the hydrological regime leading to variations in the hydrological status,

which is evident from the occurrence of perennial streams compared to the intermittent or seasonal streams in the catchment dominated by degraded forest patches in the Western Ghats. The streams are perennial when its catchment is dominated by vegetation (>60%) of native species. This is mainly due to infiltration or percolation in the catchment as the soil is porous with the presence of native species. Diverse microorganisms interact with plant roots and soil helps in the transfer of nutrients from the soil to plants and the soil is porous. Analyses of soil sample from the catchments of perennial, intermittent streams reveal that soils in the perennial streams catchment has the highest moisture content (61.47 to 61.57%), higher nutrients (C, N and K), and lower bulk density (0.50 to 0.57 g/cc). Compared to this, catchment of intermittent and seasonal streams had higher bulk density (0.87 – 1.53 g/cc) and relatively lower nutrients [3]. The analyses provide insights of the role of forests with native species in maintaining the hydrological regime while sustaining the local demand, which is useful in the watershed (catchment/basin) management by the respective government agencies. Fragmented governance and the deteriorating ecological ethics with the lack of vision among the decision makers are the principal reasons of deforestation and land degradation.

A comparative assessment of people's livelihood with soil water properties and availability of water reveals that streams with its catchment dominated by native species vegetation (>60%) have higher soil moisture and groundwater in comparison to the catchment (of seasonal stream) during dry spell of the year. The higher soil moisture due to the availability of water during all seasons facilitates farming of commercial crops with higher economic returns to the farmers, unlike the farmers who face water crisis during the lean season. This emphasises the need



for conservation endeavour towards maintaining native vegetation in the catchment, highlighting its potential to support people's livelihood with water conservation at local and regional levels. Plantation crops (viz. areca nut, coconut, banana, betel leaf, and pepper) are the major income generating products in the catchment of perennial streams. A total amount of Rs. 3,11,701/ha/yr (year 2009-10) gross average income was generated from the plantation crops against an average expenditure of Rs. 37,043/ha/yr, (mainly for plantation maintenance), yielding a net profit of Rs. 2,74,658/ha/yr. On the contrary, for the catchment of seasonal streams, (where both plantation and rice fields were considered for income calculation) the average gross income generated was Rs. 1,50,679/ha/yr against expenditure of Rs. 6474.10/ha/yr for maintenance and field preparation. This emphasises that sustenance of water in a river ensures the food security in the region which is dependent on the land use dynamics (forest vegetation cover) in its catchment. Thus, catchment integrity plays a decisive role in sustaining water for the societal and ecological needs, which is evident from the occurrence of perennial streams in the catchment dominated by native flora, highlighting the riverscape dynamics with the hydrological, ecological, social, and environmental dimensions linkages and water sustainability.^{3,4} This provides invaluable insights to the need for integrated approaches in the river basin management in an era dominated by mismanagement of river catchment with the enhanced deforestation process, inappropriate cropping and poor water efficiency. The premium should be on conservation of the remaining native forests, which are vital for the water security (perennial streams) and food security (sustenance of biodiversity). There still exists a chance to restore the lost natural forests through appropriate conservation and management

The premium should be on conservation of the remaining native forests, which are vital for the water security (perennial streams) and food security (sustenance of biodiversity). There still exists a chance to restore the lost natural forests through appropriate conservation and management practices.

practices. Current practices adopted by 20th century decision makers have been contributing to the erosion of water retention capability in the catchment with severe water scarcity, evident from 180 to 279 districts in the country reeling under droughts during the last three consecutive years. An increase of mean temperature by 0.5°C and decline of rainy days in the Western Ghats highlights of the imminent changes in the climate with the global warming due to the increase in carbon footprint with the deforestation or reduction in de-carbonisation mechanisms.

The Western Ghats with the spatial extent of 1,60,000 sq. km constitutes only 4.86% of India's geographical area (3,287,263 sq. km) and about 1.94% (64000 sq. km) in WG are ecologically sensitive, which plays a decisive role in sustaining the water for crop cultivation in 100 million hectares in the peninsular India. Recent unfortunate instances of floods and subsequent drought (drying up of water bodies) in Karnataka, Maharashtra, and Kerala is a pointer towards the mismanagement of forests in the region. The region witnessed higher quantum of precipitation in shorter duration and as the catchment had lost the capability to retain water (due to deforestation) through infiltration, most of the rainwater moved towards ocean as overland flow resulting in

scarcity of water immediately after the rainy days and also loss of life and property with the mudslides, etc. Hence, ecologically fragile regions such as Western Ghats needs to be conserved on priority to sustain the agriculture and horticulture in the peninsular India and support the economy to realise the status of developing country with the healthy citizen and \$5 trillion economy by 2025. Lopsided developmental approaches driven by land, wood, and water mafia will only drain the nation's economy with the recurring instances of floods and droughts. □

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Emerging Civil Society Initiatives in Agriculture

Chandra Sekhara Rao Nuthalapati

This article analyses the initiatives by Padma Shri awardee farmers and agriculturalists who are paving the way forward for policy making towards better incomes for the farmer community and nutritional security.

Agriculture of today is witnessing several sustainable initiatives by farmers to improve farming techniques and to prop up their livelihoods and income. This is novel as the state generally takes care of agricultural extension and the standard development theory does not often find private involvement in technology dissemination and awareness building on best agricultural practices. The Government too has, in a way, recognised this changing landscape of agricultural development. The recent conferment of *Padma Shri* awards to 12 such farmer-leaders in 2019 is a case in point. All the awardees have been encouraging fellow farmers through their own practices as well as structured trainings.

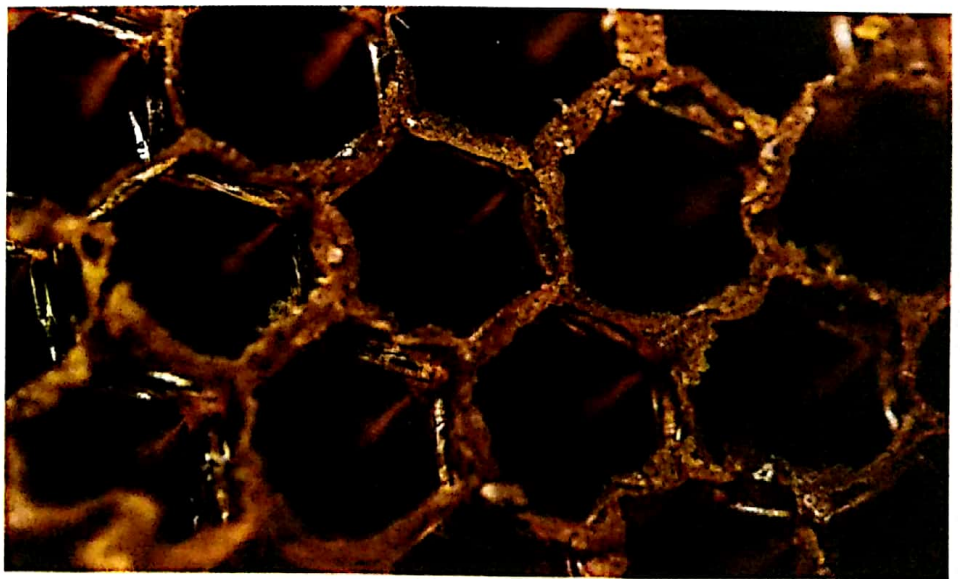
Innovations in Agriculture

Experiences of both developed and developing countries show that incremental innovations by the users of technology viz., factory workers and employees play pivotal role in improving technology and productivity.¹ juxtaposing this to agriculture, farmers can contribute similarly to agricultural development through innovation in theory. The achievements of some of the awardees endorse this hypothesis. One of the *Padma Shri* awardee

farmer, Vallabhbhai Vasrambhai Marvaniya, has been doing innovation in carrot farming since late 1940s in Junagadh of Gujarat. Subsequently, he developed 'Mudhuvan-Gajar' by decades-long selection for better yield, size, and shape. This variety is also amenable for processing. The Rajasthan Agricultural Research Institute tested this variety and endorsed its cultivation. It is popular in Gujarat, Maharashtra, and Rajasthan.

Experimenting with cauliflower cultivation since 1970, Jagdish Prasad Parikh from Rajasthan developed 'Ajita Nagar Selection' variety for better size and quality. It can be cultivated without much chemical use and the crop tolerates heat wave conditions.

The definition of innovation indicates that the use of practices not followed so far in the region and development of new products and services.² Other awardees also introduced innovation in their respective crops. Ram Saran Verma from Barabanki of Uttar Pradesh shifted to cultivating tissue-culture banana in 1988 and developed better crops each following year by developing suckers from the best banana plant with the help of tissue culture. Sultan Singh demonstrated use of re-circulating aquaculture systems (RAS) for fish cultivation in adverse climate with very limited use of water in Karnal of Haryana. Another innovation in dairy farm management by Narendra Singh from Panipat of Haryana was also awarded.



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Saalumarada Thimmakka receiving Padma Award

Minimising Chemical Use

Reducing chemical use by following organic methods of agriculture has been the focus of many of these awardees that include Yadlapalli Venkateswara Rao from Hyderabad; Bharat Bhushan Tyagi from Bulandshahr, Uttar Pradesh; Hukumchand Patidar from Jhalwar, Rajasthan; Kamala Pujari from Koraput, Odisha; and Rajkumari Devi (Kisan Chachi) from Muzaffarpur, Bihar. They also organise training for farmers on best agricultural practices and on ways for preserving local cultivars of several crops. Examples include Babulal Dahiya for paddy in Madhya Pradesh and Kamala Pujari from Odisha for paddy, turmeric, and sesame.

They encouraged fellow farmers to adopt better agronomic practices by demonstrating virtues of intercropping (Bharat Bhushan in UP and V.V. Marvania in Gujarat) and crop rotation (R.S. Verma in UP). While Kanwal Singh formed a producers'

organisation for babycorn growers in Haryana, Rajkumari formed self-help groups of women to create awareness about best agricultural practices. Virtues of cooperative agriculture are shown by R.S. Verma in UP. Almost all of these farmer-leaders have been training co-farmers in improving agricultural practices as well as in diversification and modernisation.

Diversification of Agriculture

Some of these awardees moved against traditional cropping patterns and towards improved livelihood options as well as employment opportunities for rural youth through diversification. Rajakumari experimented with food crops in place of mono-cropped tobacco and innovated agronomical methods of cultivation as per the terrain with the knowledge of soils, value addition, and marketing. Similarly, Kanwal Singh from Sonapat, Haryana, introduced cultivation of babycorn experimentally in 1997 in place of wheat and paddy and reaped higher profits. With his inspiration, more than 5000 farmers started cultivating babycorn and subsequently mushroom. They formed a society and then established their own babycorn processing plant with an investment of Rs. 1.5 crore. In this process, they created many jobs in the area. This model is proposed by him for upscaling in 150 villages of 116 districts as agricultural clusters. Both Kanwal Singh and Ram Saran Verma have been training farmers in hi-tech

agriculture and associated issues. Further, best practices in cattle rearing and dairy farm management are demonstrated by Narendra Singh in Panipat of Haryana. A desert like area around Hulikal village of Ramnagar in Karnataka was transformed to green belt by the dedicated efforts of Saalumarada Thimmakka by growing more than 8000 trees.

Shifting Consumption Patterns

The efforts of Yadlapalli Venkateswara Rao to familiarise the beneficial nutritional effects of consumption of minor millets have been altering the consumption patterns in the States of Telangana and Andhra Pradesh. As the priority shifts from food security to nutrition security, the focus of the policy makers is moving towards micro-nutrient dense foods like minor millets and pulses, often called 'orphan crops'. The Government of India declared 2018 as the National Year of Millets for promoting cultivation and consumption of these foods. It re-designated coarse

As the priority shifts from food security to nutrition security, the focus of the policy makers is moving towards micro-nutrient dense foods like minor millets and pulses, often called 'orphan crops'. The Government had declared 2018 as the National Year of Millets for promoting its cultivation and consumption. It re-designated coarse cereals like sorghum, pearl millet, finger millet, and minor millets as nutri-cereals in 2018. All this is in the 'Decade of Action on Nutrition' (2016-25) as per the United Nations under SDGs.



DD Kisan is an exclusive 24x7 channel which is entirely dedicated to the farmers of the nation. The channel has been dedicated to agriculture and related sectors, which disseminates real-time inputs to farmers on new farming techniques, water conservation and organic farming among other information. It telecasts information on agriculture and related subject for the benefit of its target audience including cattle rearers, bee keepers, poultry owners, mechanics and craftsmen. This includes information broadcast on the changing weather condition well in advance, and the low cost measures to protect crops/enhance produce during such conditions. Advice of scientists is broadcast periodically for the farmers so that they may know about the crop diseases, ways to protect crops from various diseases and on how to increase the crop yield. The Channel gives information on newer ways of agricultural practices being followed world over and the R&D in the agricultural sector across the world.

Source: <https://doordarshan.gov.in/ddkisan>

cereals like sorghum, pearl millet, finger millet, and minor millets as nutri-cereals in 2018.³ All this is in the 'Decade of Action on Nutrition' (2016-25) as per the United Nations under SDGs.

Along with these efforts by the State, the civil society has also turned the tide in bringing quick changes in consumption patterns. Rao and his associate Khadar Vali

have become household names in this region and they have inspired people in consuming minor millets like brown top millet and others. There are hyperboles too on the benefits of eating of these foods as hype always follows good practices. Often the huge demand for minor millets outpaces the supply leading to exorbitant prices. Though millet consumption has been resurging in

Karnataka,⁴ the demand in Andhra Pradesh and Telangana seems to go much beyond the upper middle classes. The moot point however is how much of this spurt in demand creation can benefit farmer-growers. Economic logic suggests that if the prices are skyrocketing, the supply is unable to catch up with the demand. The value chains for these foods have to benefit the poor farmers growing them in environmentally degraded lands and regions.

Research has to focus on increasing the productivity of minor millets that has been stagnant since the sixties. The productivity of wheat (772 kg/ha) and rice (724 kg/ha) was same as that of sorghum and pearl millet in the first four years of 1950s. While the yields for wheat and rice went up by four times since then, those of the latter two just doubled; and data for minor millets do not even exist. Therefore, huge task lies ahead for the development community that includes civil society, researchers, and the Government alike in fostering a level-playing field for minor millet farmers.



Urban Agriculture through Terrace Gardening

Growing health consciousness among the urban population for safe food and need to match the demand-supply gap between the production and demand for burgeoning population make it desirable to produce as much as possible using urban agriculture methods. The most crucial of the urban agriculture is the rooftop gardening that can make use of unused open spaces to provide food for the family, apart from reducing carbon load on environment. Rapid strides have been made in urban agriculture in several countries, most notably in the overpopulated China and health-conscious Europe. In India, few start-ups entered this segment for generating their business profits as well as for sustainable urban agriculture. While there are plenty of hobbyists and family-and-friends farmers, neither the Governments nor the non-profit organisations have recognised the full potential or need of the process.

To sum-up, the activities of these *Padma Shri* awardees has to be viewed as a trend of emerging private initiatives in various parts of the country in the challenging area of agricultural

Some of these awardees took the initiative to move against traditional cropping patterns and improved livelihood options as well as employment opportunities for rural youth through diversification. The innovative efforts of these farmer-leaders and the robust response from the farming community in transferring technologies, good agriculture practices including organic agriculture, pathways for diversification, shifting demand patterns for nutritional security and new directions like urban agriculture indicate the way forward for the country's agriculture in general and for driving up farmers' income in particular.

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agriculture practices including organic agriculture, diversification, shifting demand patterns for nutritional security and new directions like urban agriculture indicate the way forward for the country's agriculture in general and for driving up farmers' income in particular. These private initiatives have to be tailor-made to the welfare needs of masses and adopt a practical approach to agriculture diffusing good agricultural practices suited to disparate agro-ecological zones. Their efforts will achieve better results when they work in tandem with governmental and quasi-governmental agencies on addressing key challenges of the times. On the other hand, policymakers might do well to recognise successful private initiatives and internalise their efforts in broader developmental efforts by mainstreaming their activities. The scope to involve the farming community in agricultural development is huge and people have started venturing into it. It is time the development discourse needs to factor in these into the landscape of planning. □

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Managing Electronic Waste

Manjula Wadhwa

Electronic industry, one of the world's largest and fastest growing manufacturing industries, has provided some leverage to the socio-economic and technological growth of the developing society of India. However, consequence of its consumer-oriented growth combined with rapid product obsolescence and technological advances are a new environmental challenge—the growing menace of “Electronics Waste” or “e-waste” that consists of obsolete electronic devices. Solid waste management, which is already a critical task in India, is becoming more complicated by the invasion of e-waste, particularly computer waste.

Advances in information technology during the last century have radically changed Indians', especially urban citizen's lifestyle. But, its mismanagement has led to new problems of contamination and pollution. For example, personal computers (PCs) contain certain components, which are highly toxic, such as chlorinated and brominated substances, toxic gases, toxic metals, biologically active materials, acids, plastics and plastic additives, posing environmental and health challenges. This fast growing waste stream has been accelerating because the global market for PCs is far from saturation and the average life span of a PC is decreasing rapidly. The life span of central processing units (CPU) has reduced way back from 4-6 years in 1997 to 2 years in 2005.

Rapid economic growth, coupled with urbanisation and a growing demand for consumer goods, has increased both the production and consumption of electronics and electrical equipments.

While having some of the world's most advanced high-tech software and hardware developing facilities, India's recycling sector is still underdeveloped. Most people are unaware of the potential negative impact of the rapidly increasing use of computers, monitors, and televisions. When these products are dumped in landfills or incinerated, they pose health risks because of the hazardous materials they contain. Improper disposal of electronic products leads to the possibility of damaging the environment as well.

The Information Technology industry has been one of the major drivers of change in the economy since the last decade and has contributed significantly to the digital revolution in every aspect of our daily lives, providing our society with more

comfort and easy information acquisition and exchange. The Global E-Waste Monitor, 2017 published by the United Nations University estimated that India generates about 20 lakh ton of e-waste annually, nearly 82% of which is personal devices. Another study identified that computer equipment account for almost 70 per cent of e-waste, followed by telecommunication equipment like phones (12%), electrical equipment (8%) and medical equipment (7%) with remaining from household e-waste.

After understanding the magnitude of the issue, let us evaluate their impact on our environment as well as health. Electronic products actually are a complex mixture of several hundred tiny components, many of which contain deadly chemicals thereby threatening human health and the environment. Most of the components in e-devices contain lead, cadmium, mercury, polyvinyl chloride (PVC), brominated flame retardants (BFRs), chromium, beryllium etc. TVs and video and computer monitors use CRTs, which have significant amount of lead and long-term exposure to these substances can damage the nervous system, kidney and bones, and even the reproductive and endocrine systems. Some of them are highly carcinogenic. These e-wastes, when improperly disposed (incinerated/land filled instead of recycling) with domestic waste, without any controls, can contaminate the soil, water, and air. In general the



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Table 1

Materials	Weight (%)	Recycling (%)	Location	Effects
Lead	6.2988	5	Acid battery, CRT;	Kidney failure, central and peripheral nervous systems, damage to the reproductive systems;
Cadmium	0.0094	0	Battery, CRT, housing;	Long-term cumulative poison, Bone disease;
Mercury	0.0022	0	Batteries, switches, housing;	Chronic damage to brain, liver damage, damage to the central and peripheral nervous systems as well as the foetus;
Chromium VI	0.0063	0	Decorative hardener, corrosion protection agents;	DNA damage, lung cancer;
Plastic	22.99	20	Computer mouldings, cabling;	Generates dioxins and furans.

Source: <https://www.ncbi.nlm.nih.gov/>

electronic goods/gadgets are classified under three major heads:

- White goods: Household appliances;
- Brown goods: TVs, camcorders, cameras; and
- Grey goods: Computers, printers, fax machines, scanners etc.

Waste from the white and brown goods is less toxic when compared to grey goods. Table 1 shows the effect of grey goods on health.

Effects on Air, Water, and Soil

One of the most common effects of e-waste on air is through air pollution. Scavengers going through numerous landfills, looking for improperly disposed electronics to make some income from the recycling of these wastes, are exposed to such hazardous elements. When electronic items containing heavy metals such as lead, barium, mercury, lithium (found in mobile phone and computer batteries) are improperly disposed, these heavy metals leach through the soil to reach groundwater channels which eventually run to the surface as streams or small ponds of water. Resultantly, the local communities, often depending on these water bodies and the groundwater, suffer from multiple diseases. Apart from these chemicals resulting in death of aquatic plants and animals, intake of the contaminated water by humans and other animals results in lead poisoning.

Burning of e-waste in open landfill for obtaining gold and other precious metals produces fine particulate matter and causes cardio-vascular and pulmonary ailments in children. The wind carries toxic particles and they enter the soil-crop-food pathway affecting both humans and animals as they enter the food chain. The motherboards have high level of mercury and their improper disposal may cause skin and respiratory diseases. Drinking water contaminated with lead affects the central and nervous system and causes poor brain growth, dwarfism, hearing disability, and impaired formation and function of blood cells. Since, these chemicals are not biodegradable, they persist in the environment for long time, increasing the risk of exposure.

Some Solutions Addressing the issue

E-waste can be contained by minimising its generation. The product designers must ensure the longevity of the products through their' re-use, repair, and/or upgradeability features. Stress should be laid on use of less toxic, easily recoverable, and recyclable materials which can be refurbished, disassembled and remanufactured. Recycling and reuse of material are the next options to reduce generation of e-waste. Recovery of metals, plastic, glass, and other materials reduces the magnitude of e-waste. These options have a potential to conserve the energy

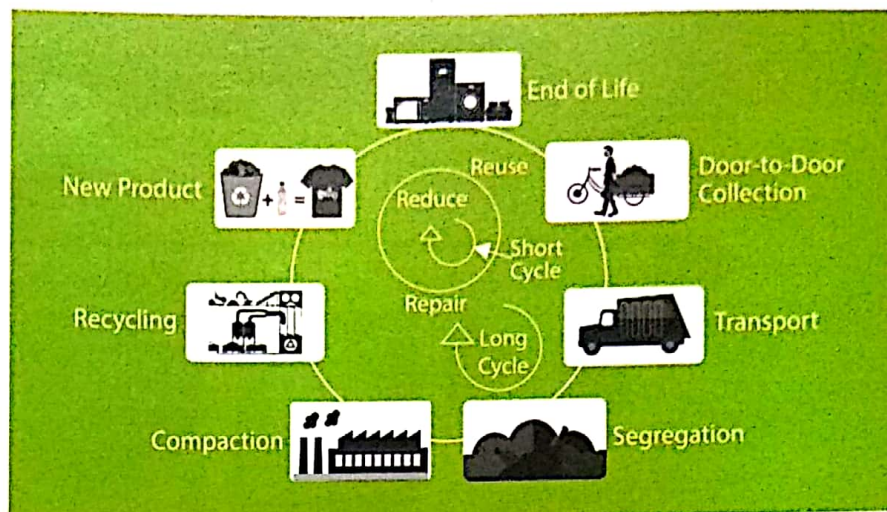
and keep the environment free of toxic materials that would otherwise have been released. Policymakers need to address all related issues ranging from production and trade to final disposal, including technology transfers for the recycling of electronic waste. Clear regulatory instruments adequate to control both exports and imports of e-wastes and ensuring their environmentally sound management should be in place. There is also a need to address the loopholes in the prevailing legal framework to ensure that e-wastes from developed countries are not dumped in our country for disposal.

Manufactures of products must be made financially, physically, and legally responsible for their products. The Eleventh International Waste Management and Landfill Symposium and regulations that cover Design for Environment and better management of restricted substances may be implemented through measures. All vendors of electronic devices shall provide take-back and management services for their products at the end of life of those products. The old electronic product should then be sent back and carefully dismantled for its parts to be either recycled or re-used, either in a separate recycling division at the manufacturing unit or in a common facility. Collection systems are to be established so that e-waste is collected from the right places ensuring that

this directly comes to the recycling unit. Each electronic equipment manufacturer shall work cooperatively with collection centres to ensure implementation of a practical and feasible financing system. Collection centres may only ship wastes to dismantlers and recyclers who have authorisation for handling, processing, refurbishment, and recycling meeting environmentally sound management guidelines.

Apart from reducing greenhouse gas emissions, which contribute to global warming, recycling also reduces air and water pollution associated with making new products from raw materials. Hybrid methodology has the potential to overcome the problems associated with chemical and biological extraction techniques for the metals present in e-waste. This strategy can provide new and emerging area of metallurgy which may facilitate the extraction of metals present in trace quantity from their ores.

EPR authorisation (Fig. 1), has been provided to 726 producers by



Source: ipcaworld.co.in

the Central Pollution Control Board (CPCB) as on 12 October, 2018, which specifies the collection targets for the specified time (five years); but unfortunately, no independent mechanism has been put in place to check or verify the claims made in authorisations resulting in slack implementation.

Recently, Ministry of Electronics and Information Technology (MeitY)

has developed a guideline on uniform inventorisation of e-waste in the country. As per information available with CPCB, 69,414 MT of e-waste was collected, dismantled, and recycled during 2017-18. On 15 July, 2019, question has been raised in Rajya Sabha on pollution due to e-waste.

Challenges Ahead

Only 1.5 per cent of e-waste generated in India gets recycled. Lack of awareness about e-waste and its recycling as well as the role of the unorganised sector are the added challenges to the problem. The base metals which can be reused are lost and result in soil contamination due to unorganised and crude dismantling. A consumer of an electric or electronic device is not apprised of the end of value chain of the product. Often, information is not provided along with the product packing about the e-collection centre for the product sold. The responsibility of the consumers is not specified along with the product.

Technical and policy-level interventions, proper implementation, capacity building, and increasing the public awareness are the need of the time. They only can convert this challenge into an opportunity and set global credible standards concerning environmental and occupational health. □

Salient features of the E-waste (Management) Amendment Rules, 2018

1. The e-waste collection targets under EPR have been revised and applicable since 1 October, 2017. The phase-wise collection targets for e-waste in weight shall be 10% of the quantity of waste generation as indicated in the EPR Plan during 2017-18, with a 10% increase every year until 2023. After 2023 onwards, the target has been made 70% of the quantity of waste generation as indicated in the EPR Plan.
2. Separate e-waste collection targets have been drafted for new producers, i.e. those producers whose number of years of sales operation is less than the average lives of their products. The average lives of the products will be as per the guidelines issued by CPCB from time to time.
3. Producer Responsibility Organisations (PROs) shall apply to the Central Pollution Control Board (CPCB) for registration to undertake activities prescribed in the Rules.
4. Under the Reduction of Hazardous Substances (RoHS) provisions, cost for sampling and testing shall be borne by the government for conducting the RoHS test. If the product does not comply with RoHS provisions, then the cost of the test will be borne by the Producers.

The E-Waste Management Rules 2016 have been amended vide notification G.S.R. 261(E), dated March 22, 2018.

(Source: Press Information Bureau)

Development and Environment: Maintaining the Fine Balance

S. C. Lahiry

Climate change has already had significant effects on productivity and the quality of life. A balance has to be struck between industrial progress and environmental degradation caused primarily by industrial pollution. Development and environmental protection can dovetail with proper planning and management. The article studies how sustainable development does not end with sustainability of environment and resource system but it also requires sustainability of economic and social systems.

With the advent of the Industrial Revolution in the 19th century, the world moved fast towards better living—terming it as growth—but at the same time, degrading the purity of nature in all forms. The Stockholm Conference held in 1972, on the “human environment” brought to light the urgency of tackling environmental problems through various efforts. Environment is of course a critical challenge to continuation of our growth and to the extent of which growth translates into improved quality of life. Many of our cities are increasingly experiencing high levels of pollution. If we cannot protect our environment at present level of development, greater growth will make matters far worse. The consequences of rapidly falling water tables in many parts of the country are already threatening our sustainability. Climate change has already had significant effects on productivity and the quality of life in India whereas we need to be at the forefront of global

efforts to combat it.¹ The purpose of economic development in any region is to provide opportunities for improved living and jobs to people. While industrial development invariably creates more jobs in any region, possibilities of adverse effects on the environment also increase. Dust, smoke, fumes, and toxic gas emissions occur because of highly-polluting industries such as thermal power plants, coal mines, cement,

sponge iron, steel & ferroalloys, petroleum and chemicals, etc. In industry-specific clusters, these have not only become hazardous, but also cause irreparable damage to our ecology and environment, often breaching the environment’s carrying capacity.²

Environmental protection measures have become necessary for development and to sustain environment at the same time. It is all



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the more important for India where economic development is necessary to meet the growing demand of people. However, indiscriminate degradation of environment in the name of economic progress is unwarranted. A balance has to be struck between industrial progress and environmental degradation which is caused primarily by industrial pollution. Sustainable development does not end with sustainability of environment and resource system; it also requires sustainability of economic and social systems. Development and environmental protection can easily go together. It would be better to begin new projects with built-in environmental safeguards rather than make haste only to regret later. Growth without environmental safety can prove counterproductive in the long run. The Bhopal gas tragedy is still fresh in the minds of the people. Unfortunately, no foolproof measure has yet been devised to cope with such unforeseen accidents which is very necessary to safeguard the health of the people living near the plants.

High emission level of pollutants at industrial clusters has been reported in Raipur-Durg, Korba-Bilaspur, Agra-Kanpur, Vapi-Ankleswar, Dhanbad-Bokaro, Vizag, Tarapur, Ludhiana, and so on. This is despite the fact that the number of power plants switched over to super-critical

technology. Steel, cement, chemicals, and petroleum refineries have also adopted state-of-the-art technologies. Adequate and effective pollution control measures are required so that adverse effects on the environment are minimised. There is a need to review

The gap between the thermal power and solar power has been narrowing. In 2018, renewable energy has reached 73 GW accounting for over 20 per cent. The installed capacity of renewable energy in the country recorded 83.4 GW as on 31 October, 2019 while wind energy accounts for 37 GW and Solar 31.7 GW. Apart from increasing share in green energy and adopting latest technologies in fossil fuel-based plants, a host of measures are being undertaken to reduce India's carbon footprint; while coal and other fossil fuels will continue to play a major role in India's energy mix in the decades to come, it is committed to tackling climate change.

and rework the strategies of setting up industry-specific clusters based on comparative advantage.

India's installed capacity of diesel generating sets forms a third of its total grid connected capacity. Toxic fumes emitted by burning diesel in Diesel Generator sets have serious implication and power thus generated is also expensive. As a deterrent, incentives for both capital investment and power generation by solar rooftop have been encouraged.³ Various policy inducements have translated into lower generation cost. Tariffs for solar power have fallen to record low due to the Government's solar energy drive aimed at reducing greenhouse gas emissions. The gap between the thermal power and solar power has been narrowing. In 2018, renewable energy has reached 73 GW accounting for over 20 per cent. The installed capacity of renewable energy in the country recorded 83.4 GW as on 31 October, 2019 while wind energy accounts for 37 GW and Solar 31.7 GW. Apart from increasing share in green energy and adopting latest technologies in fossil fuel-based plants, a host of measures are being undertaken to reduce India's carbon footprint; while coal and other fossil fuels will continue to play a major role in India's energy mix in the decades to come, it is committed to tackling climate change.

Clean technology essentially means a process that minimises use of raw materials and produces minimal waste. Globally, environmental trends are reshaping the industry. There are plenty of examples of clean technologies round the globe. The growth in clean technology industry will definitely help in making sustainable and safe environment for next generations. International Energy Agency (IEA) claims that clean energy technologies and policies can indeed meet multiple objectives in the most effective way. For example, sustainable mobility solutions can increase access to services while

reducing congestion and increasing productivity. Efficient building technologies can reduce energy investment needs while increasing comfort for residents. Local sources of energy and integrated distribution systems can decrease the costs associated with delivering various services, while improving resiliency and flexibility.

The Government has launched National Clean Air Programme (NCAP) as a long-term, time bound, national level strategy to achieve 20 to 30 per cent reduction in PM10 and PM2.5 concentration by 2024. Overall objective of the NCAP is comprehensive mitigation actions for prevention, control, and abatement of air pollution besides augmenting the air quality monitoring network across the country and strengthening the awareness and capacity building activities.

The NCAP will be a mid-term, five-year action plan with 2019 as the first year. The approach for NCAP includes collaborative, multi-scale, and cross-sectoral coordination between the relevant central ministries, state governments and local bodies. Dovetailing of the existing policies and programmes including the National Action Plan on Climate Change (NAPCC) and other initiatives of the Government with reference to climate change will be done while execution of NCAP.

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The United Nations Framework Convention on Climate Change (UNFCCC) defines "climate change" as a change in climate attributed directly or indirectly to human activity that alters the composition of global atmosphere. It is observed over comparable time periods in addition to natural climate variability. The major characteristics of climate change include rise in average global temperature, icecap melting, changes in precipitation and increase in ocean temperature leading to sea level rise. The efforts needed to address climate change include mitigating greenhouse gas (GHG) emissions on one hand and building

adaptive capacities on the other. India is committed to the UNFCCC and the Kyoto Protocol, which represent international consensus on the ways to deal with climate change. It has a very comprehensive framework of legal and institutional mechanisms in the region to respond to the tremendous challenges to the environment and has initiated several climate-friendly measures, particularly in the renewable energy sector.

India inked Paris Climate Change deal on 2 October, 2016, a landmark pact which calls on countries to combat climate change and limit global temperature rise to well below 2 degrees Celsius. Incidentally, the Paris deal adopted by 195 countries in 2015 (leading player of GHG emission, the USA opted out) aims to limit global warming to 1.5 degree Celsius, considering pre-industrial level as the baseline. Paris hosted and spearheaded the One Planet Summit in 12 December, 2017. The event was aimed at sustaining momentum on climate action and to ring together civil society, private sector, and also national, regional, and local governments. The focus was on climate finance—both public and private—and to retain and defend the essence of operationalising some of the commitments to reduce GHG emission and switch to low-carbon path. At the summit, 60 heads of States and business leaders vowed to fight climate change. Regarding financing climate plan, the EU is reported to provide the \$100-billion-a-year grant that developed countries have committed to by 2020. Japan plans to contributing to the Global Climate Fund (GCF) and focusing on adaptation efforts in vulnerable areas like Pacific Islands. Seeking to boost the global economy's shift to clean energy, the World Bank announced at the Summit that it would stop financing oil and gas exploration and extraction from 2019. The move was meant to help countries meet the GHG curbing pledges they had made in



support of the 2015 Paris Agreement. Despite such development, however, according to Annual audit report of United Nation Environment Programme (UNEP), national pledges on emission reduction made by countries under Paris Agreements will only account for one-third of what is needed to avoid the worst impact of climate change. Even full implementation of the countries' unconditional 'NDC' (nationally determined contributions) would lead to temperature increase of at least 3 degree Celsius by 2100. It means Governments have to urgently deliver much stronger pledges when revised in 2020.

India announced its new climate plan, also known as Intended Nationally Determined Contribution, (INDC) in 2015. India's INDC targets installing 175 GW of renewable energy capacity by 2022 (out of this, 100 GW has been allocated to solar and 60 GW to wind) by increasing its share of non-fossil based energy from 30 per cent to about 40 per cent by 2030. It has committed to reduce its emissions intensity per unit GDP by 33 to 35 per cent by 2030 and create an additional carbon sink of 2.5 to 3 billion tonnes of CO₂ through additional tree cover. The Prime Minister in a recently held Climate Action Summit at New York (October-November 2019)

has asserted that India was going to increase energy produced from non-fossil fuels to 175 GW by 2022 and would further it to 450 GW. India's report on climate action plan under the Paris Agreement suggests that over 80 per cent of the 51 companies are responding to carbon disclosure project (CDP). India's climate change programme has reported one or more types of emission reduction targets and initiatives in 2017. It noted that 40 per cent companies are committed to renewable energy production and consumption targets with three of them even committing to 100 per cent renewable power in due course. The Indian companies are increasingly adopting internal carbon pricing (ICP) as an important tool for managing climate risks. ICP provides incentives to relocate resources towards low-carbon activities. Just 478 units reduced 2 per cent of India's annual CO₂ emission.⁴ The CDP India Annual Report (of 2018) noted that 13 companies are using ICP and 24 companies anticipate incorporating ICP in the next 2 years as compared to 11 and 20 companies, respectively, in 2017. In 2019, 37 companies in India were in the process of adopting ICP including major cement producer.⁵

However, to a large extent, an effective pollution regulation system will reduce the emissions of green

house gases. At the operational level, the industries have to be closely monitored by a responsive and competent body which would create a more predictable and smoother regulatory environment, setting regulatory standards in new areas necessitated by development and enforce regulations effectively. There is need to improve the capabilities as well as strengthen the our regulatory institutions. The Central and State pollution control boards are understaffed and often lack infrastructure. It may be pointed out that the Central Pollution Control Board has a few hundred employees compared to 14000 at the US Environmental Protection Agency and number of scientists is even fewer⁶ while the State Pollution Control Boards function at sub-optimal levels due to gap in the capacity of enforcement and inadequate infrastructure. The Delhi Pollution Control Committee has less than 30 scientists and engineers dealing with air pollution in the NCR whereas Mexico city has over 200.⁷ There is an urgent need to strengthen these agencies by recruiting professionals, taking up R&D work and provision of better infrastructural support. □

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Plastic Waste in Construction and Road Making

Dr. Ashok G. Matani

Melting down old plastic waste to repurpose it into useful new items is one of the ways of reducing the plastic in the oceans and landfills. Initiatives are being taken to use plastic waste out of landfills in building roads. Plastic Road is a circular product based on recycled plastics. It has significantly smaller carbon footprint than traditional road construction materials used because of its longer lifespan and reduced transportation of material involved.

The Government of India is encouraging waste plastic usage for roads and highway construction, especially on National Highways within 50 km periphery of urban areas that have a population of 5 lakh or more. The Ministry of Road Transport & Highways has mobilised nearly 26 thousand people across the country for spreading awareness on plastic waste management. Over 61 thousand hours of *Shramdaan* has been initiated to collect plastic waste. This has resulted in collection of nearly 18 thousand kg of waste plastic throughout the country. Every 10 tons of asphalt made with it uses 71,432 plastic bottles or 435,592 plastic bags.

Unmanaged plastic waste negatively impacts the natural environment and creates problems for plants, wildlife, and human population. Plastic is a useful material; but it is made of toxic compounds known to have health impacts. Also, because it is meant for durability, it is not easily biodegradable and takes hundreds or even thousands of years to break down. It is not just the accumulation of plastics that harms the environment—it is also the

fragments and toxins released during photo-decomposition that pollute our soil and water.¹

As the world's population continues to grow, amount of garbage generated is also growing. On-the-go lifestyles require easily disposable products, but the accumulation of these products has led to increasing amounts of plastic pollution around the world.²

Melting down old plastic waste to repurpose it into useful new items is one of the ways of reducing the plastic in the oceans and landfills. Initiatives are being taken to use plastic waste out of landfills in building roads. Post-consumer Recycled (PCR) garbage is used in creating new polymer modified asphalt roads. These are found to be more resistant to erosion from weather and vehicle use, and the number of new potholes



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formed is reduced. A project in the Netherlands used plastic waste from ocean in road constructions. These roads are claimed to last 50 years or three times longer than conventional roads and can survive extremely hot or cold temperatures for all climate use. In the UK, a factory is dedicated to converting plastic waste into an asphalt mixture for using in roads, parking lots and driveways. National Rural Roads Development Agency, Ministry of Rural Development, Government of India has issued guidelines for the use of plastic waste in rural roads construction.

The following types of waste plastics can be used in the construction of rural roads:

- Films (Carry Bags, Cups) thickness up to 60 micron (PE, PP, and PS);
- Hard foams (PS), any thickness;
- Soft foams (PE and PP), any thickness; and
- Laminated plastics with thickness up to 60 micron (aluminium coated also) packing materials used for biscuits, chocolates, etc.

Polyvinyl chloride (PVC) sheets or Flux sheets should not be used in any case. Further, the waste plastic modifier should be free from dust and is to be shredded, preferably to 2-3 mm particle size. While Central Road Research Institute (CRRI) specified that the shredded waste plastic should pass through 3 mm sieve, one expert has suggested it to pass through 4.75 mm sieve and retained on 1 mm. This also indicates indirectly that the size of the shredded bitumen should normally be 2-3 mm for better spread and coating the aggregate.

Method of Road Laying

Dry process is recommended for isolated works. CRRI has recommended that the percentage of shredded waste plastic will be 8% as the optimum plastic content



for blending the bitumen in the construction of plastic roads. Bitumen of grades 60/70 or 80/100 can be used as binder as in case of conventional method.³

The stone aggregate mix (as per specification) is transferred to the mix cylinder where it is heated to 165°C (as per the IRC specification) and then it is transferred to the mixing puddler (temperature can be monitored using IR thermometer). While transferring the hot aggregate into the puddler, calculated quantity of shredded plastics is sprayed over the hot aggregate within 30 seconds. The sprayed plastic films melts and gets coated over the aggregate, thus forming an oily coating.

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Similarly, the bitumen is to be heated to a maximum of 160°C in a separate chamber and kept ready (the temperature should be monitored to have good binding and to prevent weak bonding). At the mixing puddler, the hot bitumen is added over the plastic coated aggregate and the resulted mix is used for road construction. The road laying temperature is between 110°C to 120°C. The roller used is normal 8-ton capacity. For intensive works, Central Mixing Plant can also be used.

Major Findings

Use of plastic along with bitumen in construction of roads not only increases its life and smoothness but also makes it economically sound and environment friendly. Plastic waste used as modifier of bitumen improve some of the properties of bitumen. Further it has been found that such roads were not subjected to stripping when come in contact with water. Use of higher percentage of plastic waste reduces the need of bitumen by 10%. It also increases the strength and performance of the road. It has been proved by various studies that the coating of plastics and rubber reduces the porosity, absorption of moisture, and improves soundness.

Looking ahead, we do not appear to be approaching the end of the 'plastic age' and there is much that plastics can contribute to society. Plastic materials have the potential to

bring scientific and medical advances, including tissue and organ transplants; lightweight components, such as those in the modern aircrafts will reduce fuel usage in transportation; components for generation of renewable energy and insulation will help reduce carbon emissions and smart plastic packaging will no doubt be able to monitor and indicate the quality of perishable goods.⁴

Under the 'Swachhata Hi Sewa' programme of the Government of India, awareness programmes are being organised at campsite/local community centres, publicity through FM Radio, cleaning of National Highways and collection of plastic waste/polythene bags/plastic bottles, cleaning up toll plazas, and organising Swachhata Workshops for truck drivers and toll employees. The Government is also discouraging the use of plastic water bottles, installing dustbins for collection of segregated waste, and is distributing cloth/jute bags. A stretch of road has recently been constructed using waste plastic on NH-48 near Dhaula Kuan. A portion of Delhi-Meerut expressway and Gurugram-Sohna road has also been planned for construction using plastic waste.

Plastics offer considerable benefits for the future, but it is evident that our current approaches to production, use, and disposal are not sustainable and present concerns for wildlife and human health. We have considerable knowledge about many of the environmental hazards and information on human health effects is growing, but many concerns and uncertainties remain. There is a role for individuals, via appropriate use and disposal, particularly recycling; for industry by adopting green chemistry, material reduction and by designing products for reuse and/or end-of-life recyclability and for governments and policymakers by setting standards and targets, by defining appropriate product

Our current approaches to production, use, and disposal of plastics have not been sustainable. Appropriate use and disposal, particularly recycling; for industry by material reduction and by designing products for reuse and/or end-of-life recyclability and for governments and policymakers by setting standards and targets, by defining appropriate product labelling to inform and incentivise change and by funding relevant academic research and technological developments.

labelling to inform and incentivise change and by funding relevant academic research and technological developments. These measures must be considered within a framework of lifecycle analysis and this should incorporate all of the key stages in plastic production, including synthesis of the chemicals that are used in production, together with usage and disposal. □

Endnotes:

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National Voters' Day 2020

'Electoral Literacy for a Stronger Democracy'

Umesh Sinha

Mandate for universal equal suffrage emanates from Article 326 of the Constitution. The mandate was further enhanced with the Constitution (Sixty-first Amendment) Act, 1988 that reduced the voting age to 18 years. As per its mandate, the Election Commission made sustained efforts to enrol all eligible electors. On 25 January, 2020, National Voters' Day (NVD) celebration is completing a decade. Every year this day is observed at over 10 lakh locations all over the country that include polling station areas, sub-divisions, divisions, district, and at State headquarters. On this day, the entire nation reverberates with the festivities of democracy as crores of Indians celebrate their right to vote.

National Voters' Day is celebrated since 2011 to mark the Foundation day of the Election Commission of India (ECI), which was established on this day in the year 1950.

Every vote counts in the elections. NVD was initiated in 2011 by the Commission to highlight the value of vote and importance of every vote in democracy. NVD marks the Foundation day of Election Commission of India, which was established on this day in the year 1950. The main purpose of the celebration is to encourage, facilitate, and maximise the enrolment, especially for the new voters. Dedicated to the voters of the country, the day is also utilised to spread awareness for effective participation in the electoral process.

Each year, simultaneous celebrations are organised at the National level, State level, district level down to the polling station level making it the largest celebration of

democracy in the world.

National level function is organised at New Delhi by ECI where Hon'ble President of India graces the occasion as Chief Guest. Awards are given away to the National, Special and Zonal recipients besides the 'Best State Award' and 'Media Awards' for excellence, proficiency, and innovation in electoral process and outstanding performance. Best Practices in Election Management in the fields of Voter Education, Security Management, Infrastructure

Management, Expenditure Monitoring and Tackling Money Power, Use of Technology, Management of Electoral Rolls, Innovation etc. are considered. The selection process is fairly comprehensive and aims at eliciting the best of the talent and performance among election officials and stakeholders. New voters (18+ years old) are given their Elector Photo Identity Card. Stakeholders in other categories are also felicitated. Guidance from the Hon'ble President and Chief Election Commissioner inspire citizens towards commitment to maximise electoral participation.

At the State level, the Chief Electoral Officers (CEOs) organise similar celebration in association with state administration, State Election Commission, media, Civil Society organizations (CSOs), educational institutions, youth organisations, representatives of political parties etc. Hon'ble Governor of the respective State presides over State-level functions. State



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awards for excellence, proficiency and innovation in electoral process, and outstanding achievement are given at these functions.

At the district level, District Election Officers (DEOs) organise similar events including voter education activities. Panchayats, academic institutions, CSOs, media, youth and as such all sections of the society and citizens also get involved. The Booth Level Officers (BLOs) in polling station areas felicitate new voters at a brief ceremony and hand over Elector Photo Identity Card to them. Moreover, the freshly eligible and registered voters are given a badge with slogan 'Proud to be a Voter – Ready to Vote'; and all participants are administered Voters' Pledge.

Voters' Pledge is administered to every participant on National Voters' Day during the celebration at each level. The Pledge conveys Commission's commitment to ensure 'Informed and Ethical Voting'.

Voters' Pledge

We, the Citizens of India, having abiding faith in democracy, hereby pledge to uphold the democratic traditions of our country and the dignity of free, fair and peaceful elections, and to vote in every election fearlessly and without being influenced by considerations of religion, race, caste, community, language or any other inducement.

NVD celebrations focus on a specific theme every year. The theme sets the tone for the activities conducted throughout the year. Year-wise themes are as follows:

- 2011: Greater Participation for a Stronger Democracy
- 2012: Women's Registration
- 2013: Inclusion
- 2014: Ethical Voting
- 2015: Easy Registration, Easy Correction
- 2016: Inclusive and Qualitative Participation; No voter to be left behind

- 2017: Empowering Young and Future Voters
- 2018: Accessible Elections
- 2019: No Voter to be Left Behind
- 2020: Electoral Literacy for a Stronger Democracy.

ECI launched the Electoral literacy programme under SVEEP on the eve of 8th NVD and by now about 5.8 lakh Electoral Literacy Clubs (ELC), Chunav Pathshalas, and Voter Awareness Forums have been set up across the country. These forums work on the principle of engaging the target populations through hands-on experience on the electoral process. The ELCs operate at the level of schools, colleges, and other institutions of learning; Chunav Pathshalas operate at community levels; and the Voter Awareness Forums operate at the level of organisations including Government offices. The programme is envisaged to expand and cover all the institutions.

Mandate for universal equal suffrage emanates from Article 326 of the Constitution. The mandate was further enhanced with the Constitution (Sixty-first Amendment) Act, 1988 that reduced the voting age to 18 years. As per its mandate, the Election Commission made sustained efforts to enrol all eligible electors. Yet, voters' apathy and lack of enrolment and participation of certain sections of society, especially the new voters (18+), was a challenge. During the Diamond Jubilee celebration in 2010, the Commission had a focused analysis of both, the enrolment and electoral participation, especially among the young voters.

The Commission decided to take up a rigorous exercise to identify all eligible voters attaining the age of 18 as on 1st January every year in each polling station area of the country, enrol them and handover their Elector Photo Identity Cards on 25 January. The initiative aimed at providing the youth a sense of citizenship, empowerment, and pride in electoral participation as also to inspire them in exercising the newly acquired franchise. Thus, as a measure of enhancing participation

of citizens, especially the youth in democratic electoral process, ECI decided to celebrate 25 January, its Foundation Day, as the National Voters' Day every year.

Outcomes in terms of enrolment of voters emanating from the NVD initiative have been encouraging.

The Lok Sabha Elections 2019 saw a historic voter turnout of 67.47%. Voter turnout had increased to a record 66.44% in 2014 from 58.19% in 2009. The number of electors that was 83.4 crore on the eve of 2014 General Elections rose to 91 crore ahead of Lok Sabha Election 2019. This is an addition of over 7.46 crore electors which included 4.07 crore women and 3.3 crore men.

Moreover, women participation also increased to a historic 66.79% in 2019 reducing the gender gap to 0.01% as compared to 1.46% in 2014 elections. Also, with an aim to ensure accessible elections, 62 lakh Persons with Disability (PwD) electors were identified.

At present, about 91 crore Indian citizens are registered as voters. The Commission has demonstrated fulfilment of its mandate through conduct of successive elections in the country right from 1950 onwards. The strength of its electoral processes is seen both with awe and respect among democracies of the world. Today, the electoral operations of India are the largest in the world as demonstrated in the Lok Sabha Election 2019 where about 1.2 crore polling officials worked at over 10 lakh polling stations in the country.

A voter is the central unit of a democracy and its electoral processes. NVD connects voters with the electoral process and renews both, their relevance and contribution to the democracy.

NVD inspires the voters, the key stakeholder in democratic polity besides other stakeholders including election machinery. Today, NVD initiative has been institutionalised as an annual feature for celebration of democracy and electoral participation in the country. □

Tiger Corridors in India

The National Tiger Conservation Authority in collaboration with the Wildlife Institute of India has published a document titled **"Connecting Tiger Populations for Long-term Conservation"**, which has mapped out 32 major corridors across the country, management interventions for which are operationalised through a Tiger Conservation Plan, mandated under section 38V of the Wildlife (Protection) Act, 1972. The list of macro/landscape level tiger corridors are as under:

Landscape	Corridor	States/Country
Shivalik Hills & Gangetic Plains	(i) Rajaji-Corbett	Uttarakhand
	(ii) Corbett-Dudhwa	Uttarakhand, Uttar Pradesh, Nepal
	(iii) Dudhwa-Kishanpur-Katerniaghat	Uttar Pradesh, Nepal
Central India & Eastern Ghats	(i) Ranthambhore-Kuno-Madhav	Madhya Pradesh, Rajasthan
	(ii) Bandhavgarh-Achanakmar	Madhya Pradesh, Chhattisgarh
	(iii) Bandhavgarh-Sanjay Dubri-Guru Ghasidas	Madhya Pradesh
	(iv) Guru Ghasidas-Palamau-Lawalong	Chhattisgarh & Jharkhand
	(v) Kanha-Achanakmar	Madhya Pradesh, Chhattisgarh
	(vi) Kanha-Pench	Madhya Pradesh, Maharashtra
	(vii) Pench-Satpura-Melghat	Madhya Pradesh, Maharashtra
	(viii) Kanha-Navegaon Nagzira-Tadoba-Indravati	Madhya Pradesh, Maharashtra, Chhattisgarh, Andhra Pradesh
	(ix) Indravati-Udanti Sitanadi-Sunabeda	Chhattisgarh, Odisha
	(x) Similipal-Satkosia	Odisha
	(xi) Nagarjunasagar-Sri Venkateshwara National Park	Andhra Pradesh
Western Ghats	(i) Sahyadri-Radhanagari-Goa	Maharashtra, Goa
	(ii) Dandeli Anshi-Shravathi Valley	Karnataka
	(iii) Kudremukh-Bhadra	Karnataka
	(iv) Nagarhole-Pusphagiri-Talakavery	Karnataka
	(v) Nagarhole-Bandipur-Mudumalai-Wayanad	Karnataka, Kerala, Tamil Nadu
	(vi) Nagarhole-Mudumalai-Wayanad	Karnataka, Kerala, Tamil Nadu
	(vii) Parambikulam-Eranikulam-Indira Gandhi	Kerala, Tamil Nadu
	(viii) Kalakad Mundanthurai-Periyar	Kerala, Tamil Nadu
North East	(i) Kaziranga-Itanagar WLS	Assam, Arunachal Pradesh
	(ii) Kaziranga-Karbi Anglong	Assam
	(iii) Kaziranga-Nameri	Assam
	(iv) Kaziranga-Orang	Assam
	(v) Kaziranga-Papum Pane	Assam
	(vi) Manas-Buxa	Assam, West Bengal, Bhutan
	(vii) Pakke-Nameri-Sonai Rupai-Manas	Arunachal Pradesh, Assam
	(viii) Dibru Saikhowa-D'Ering-Mehaong	Assam, Arunachal Pradesh
	(ix) Kamlang-Kane-Tale Valley	Arunachal Pradesh
	(x) Buxa-Jaldapara	West Bengal

Further, a 3-pronged strategy to manage human-tiger negative interactions has been advocated as follows:

1. **Material and logistical support:** Funding support through the ongoing Centrally Sponsored Scheme of Project Tiger, is provided to tiger reserves for acquiring capacity in terms of infrastructure and material, to deal with tigers dispersing out of source areas. These are solicited by tiger reserves through an Annual Plan of Operation (APO) every year which stems out from an overarching Tiger Conservation Plan (TCP), mandated under Section 38 V of the Wildlife (Protection) Act, 1972. *Inter alia*, activities such as payment of ex-gratia and compensation, periodic awareness campaigns to sensitize, guide and advise the general populace on man-animal conflict, dissemination of information through various forms of media, procurement of immobilization equipment, drugs, training and capacity building of forest staff to deal with conflict events are generally solicited.
2. **Restricting habitat interventions:** Based on the carrying capacity of tigers in a tiger reserve, habitat interventions are restricted through an overarching TCP. In case tiger numbers are at carrying capacity levels, it is advised that habitat interventions should be limited so that there is no excessive spill over of wildlife including tigers thereby minimizing man-animal conflict. Further, in buffer areas around tiger reserves, habitat interventions are restricted such that they are sub-optimal vis-à-vis the core/critical tiger habitat areas, judicious enough to facilitate dispersal to other rich habitat areas only.
3. **Standard Operating Procedure (SOPs):** The National Tiger Conservation Authority has issued following three SOPs to deal with man-animal conflict which are available in public domain:
 - a. To deal with emergency arising due to straying of tigers in human dominated landscapes
 - b. To deal with tiger depredation on livestock
 - c. For active management towards rehabilitation of tigers from source areas at the landscape level.



The three SOPs *inter alia* include the issue of managing dispersing tigers, managing livestock kills so as to reduce conflict as well as relocating tigers from source areas to areas where density of tiger is low, so that conflict in rich source areas does not occur.

In technical collaboration with the Wildlife Institute of India, the National Tiger Conservation Authority has also published a document titled 'Eco-Friendly measures

to mitigate impacts of Linear infrastructure on wildlife' to safeguard these corridors from linear infrastructure development besides sensitizing user agencies which *inter alia* include Indian Railway Traffic Service Probationers, National Highways Authority of India personnel, Indian Railway Engineers, besides others.

An amount of Rs. 370 crores, Rs. 345 crores and Rs. 350 crores was allocated during the financial years 2016-17, 2017-18 and 2018-19 respectively, while an amount of Rs. 350 crores has been allocated for the current financial year under the Centrally Sponsored Scheme of Project Tiger.

(Source: Press Information Bureau)