ANNEXURE

Climate Change and Environment Action Plan of Indore District

Prepared by:

VASUDHA FOUNDATION
Green ways for a good earth!

In association with:

EPCO

Supported by:

SHAKTI SUSTAINABLE ENERGY FOUNDATION

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Annexure A

Annexure to background

It is important to integrate climate change actions into the developmental planning and programme implementation processes by going beyond the state and directly involving the districts. This bottom-up approach integrates climate change mitigation into ongoing schemes, policies and programmes at the district level, which is where most of the government's ongoing initiatives and priorities integrate and converge. With SAPCCs being revised, district-specific climate action plans ensure the much-needed directional shift at the level of district administration, while taking the Nationally Determined Contributions (NDCs) and Sustainable Development Goals (SDGs) forward.

In this context, Vasudha Foundation initiated the project, to develop Climate Change and Environment Action Plan (CCEAP) for multiple districts of India with support from Shakti Sustainable Energy Foundation. In Madhya Pradesh, CCEAP has been developed for Bhopal and Indore districts in association with the Environment Planning and Coordination Cell (EPCO), Government of Madhya Pradesh. The key objectives of the CCEAP are:

- To facilitate a bottom-up approach for climate planning
- Identify local level climate change drivers and sectoral mitigation potential
- Identify and propose recommendations for sectors to enhance climate action, and address local environmental concerns
- Enhance climate accountability of district level administration

The major components, deliverables, and SDG linkages are summarised in the following table:

Major components	**Major deliverables**	**Addressing SDG**
District and climate profile	● Information on demography, administration, land-use etc. ● District profile including power sector, industry, habitat, agriculture and other natural resources, waste profile ● Observed climate variability ● Climate change projections (RCP4.5 and RCP8.5: Until the end-of-century, in time slices of 2030, 2050, 2070 and 2100)	The recommendations of the action plan directly address at least 12 of the 17 SDGs at district level: ● SDG 1: No Poverty ● SDG 2: Zero Hunger ● SDG 3: Good Health & Wellbeing ● SDG 6: Clean Water & Sanitation ● SDG 7: Affordable & Clean Energy ● SDG 8: Decent Work & Economic Growth ● SDG 9: Industry, Innovation & Infrastructure
District GHG profile and trend analysis	● Climate change direct drivers: Source-based emission estimations from the sectors of energy, AFOLU and waste since 2005 to latest year (using IPCC methodology and as per data availability) and projections until 2030 – BAU ● Carbon footprint of electricity consumption trends and projections – BAU	
Policy impact evaluation	● Climate (GHG) impact evaluation of sector specific policies/schemes (energy, AFOLU, waste, cross-cutting) on the basis of year-on-year target (indicators) achieved	
Budgetary allocation analysis	● Analysis of budget: District budget (where available) and flagship schemes to identify	

	allocation for climate action (both mitigation and resilience) using CPEIR methodology	● SDG 11: Sustainable Cities & Communities ● SDG 12: Responsible Consumption & Production ● SDG 13: Climate Action ● SDG 15: Life on Land ● SDG 17: Partnerships for the Goals
Recommendations	● District-specific sectoral recommendations based on the findings of emission profile and situation and policy analysis ● Indicating a timeline (to achieve the recommendations), identifying schemes/ programmes and departments/agencies for implementation of proposed measures and linking them with SDGs ● Recommendations based on district-specific environmental problems ● Individual climate action and suggesting behavioural change communication techniques ● Proposed monitoring and evaluation plan and an institutional set-up	
Impacts of COVID-19	● Changes in electricity and fuel consumption pattern, waste generation and management, migration behaviour, etc. ● A comparative study of air pollution between pre-Covid times and during the pandemic.	

Annexure 1

District profile

1.1. Industries in Indore district

Table 1: Industries at a glance – Indore district[1]

S.No.	Head	Unit	Particular
1	Registered industrial units	No.	12,726
2	Total industrial units	No.	12,726
3	Registered medium and large units	No.	21
4	Estimated average number of daily workers employed in small scale industries	No.	-
5	Employment in large and medium industries	No.	-
6	Number of Industrial areas	No.	07
7	Turnover of medium and large-scale industries	Crore	-

Table 2: Details of existing micro and small enterprise and artisan units in the district

NIC Code	Type of Industry	Unit (No.)	Investment (₹ lakh)	Employment
20	Agro based	370	163.24	1110
22	Soda water	-	-	-
23	Cotton textile	44	792.20	2640
24	Woollen, silk and artificial thread-based cloth	79	43.45	158
25	Jute and jute based	35	15.75	70
26	Readymade garment and embroidery	634	158.50	4438
27	Wooden and wooden based furniture	30	10.50	120
28	Paper and paper products	177	531.00	1062
29	Leather based	431	21.55	862
30	Rubber, plastic and petro-based	265	927.50	795
31	Chemical/ chemical based	179	1432	716
32	Mineral based	27	270	162
33	Metal based	430	193.50	1290
35	Engineering units	101	55.55	404
36	Electrical machinery and transport equipment	106	42.4	318
97	Repair and servicing	920	230	1840
01	Others	67	10.05	201

[1] MSME: District Industrial Profile of Indore District (2016)

Annexure 2

Climate profile and projections

2.2 Background note

Global warming has significant impacts on the changes in extreme weather and climate events. The Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC) confirms that rising anthropogenic greenhouse gas (GHG) concentrations are responsible for the unusual warming of the planet in recent decades. They also cause frequent high intensity temperature/precipitation extremes with prolonged duration, impacting the living and working environments. These changes are reported to have impact on the social and economic sectors of the society (IPCC 2013). Numerous studies have highlighted the increase of temperature and precipitation extremes with high regional variations across the globe. The recent decade has witnessed a high number of extreme precipitation events such as floods/droughts in different parts of the world. Though there is a decrease in annual precipitation, heavy/extreme precipitation events have increased substantially in many regions of the world.

High-resolution modelling or downscaling of general circulation models (GCMs) to higher resolution is essential to obtain the future extremes and their variability under global warming. A key advantage of high-resolution regional climate simulations is their capability to show the mean as well as extreme temperature and precipitation events. In this report, the daily rainfall and minimum and maximum temperatures from National Aeronautics and Space Administration (NASA) Earth Exchange Global Daily Downscaled Projections (NEX-GDDP, Thrasher et al. 2012) dataset have been evaluated with India Meteorological Department (IMD) high-resolution daily gridded rainfall data (0.25^{o} x 0.25^{o} , Pai et al. 2015) and daily gridded maximum and minimum temperature data (1^{o} x 1^{o} , Srivastava et al 2014) for the period 1986–2005 and the possible future changes in mean and various indices of extreme temperature and precipitation have been examined under two emission scenarios RCP4.5 and RCP8.5. The analysis is focused on the distribution of temperature and precipitation changes for baseline period and its future scenarios for 2030s (2021-2050), 2050s (2041-2060), 2070s (2061-2080) and 2090s (2081-2100). It will help policymakers quantify the potential impacts of extreme events and enable the formulation of appropriate adaptation strategies.

2.2 Data source and methodology

The NEX-GDDP datasets (0.25° × 0.25° long/lat) covering the entire globe, bias corrected, high-resolution statistically downscaled product, derived from 20 general circulation models (GCMs), under the coupled model inter-comparison project phase 5 (CMIP5), and across two greenhouse gas emissions scenarios of RCP4.5 and RCP8.5 have been used in this analysis. This dataset is mainly generated by using the bias-correction spatial disaggregation (BCSD) method (Wood et al. 2004; Thrasher et al. 2012). These NEX- GDDP datasets include downscaled projections for precipitation and minimum and maximum surface air temperature for the 20 models (Table 3). The present-day simulations are for the period 1950 to 2005 for each experiment, and future projections from 2006 to 2100 for two scenarios RCP4.5 (mid-range emissions) and RCP8.5 (high-end emissions).[2]

The NEX-GDDP dataset helps carry out studies on various aspects of climate change and their impacts at local and regional scales. In this present work, we have used the multi-model mean (MMM) approach to investigate the comparison between observational dataset (IMD) and of the NEX-GDDP

[2] NASA Centre for Climate Simulation: https://www.nccs.nasa.gov/services/climate-data-services

simulations in the baseline period. The advantage of using the MMM is that it usually outperforms any individual model and averages out internal variability.

The present study investigates the projected changes in mean and extreme temperature and precipitation events over south peninsular India for different time slices with reference to the baseline period (1986–2005). The projected changes in precipitation extremes, such as rainy days (a day with precipitation more than 2.5 mm) and the temperature extremes such as warm days (correspond to cases when the maximum temperature exceeds the 90th percentile) and cold days (correspond to cases when the minimum temperature exceeds the 10th percentile) have been analysed using these high-resolution datasets.

The observed data was analysed (over the past 68 years) to study current climate variability over six districts. Precipitation, maximum, and minimum temperature datasets are used as the key climate variables in this analysis.

GCMs of NEX-GDDP dataset (Source: Thrasher et al. 2012)

Table 3: GCMs of NEX-GDDP dataset[3]

Modeling center (or group)	**Institute ID**	**Model name**
Commonwealth Scientific and Industrial Research Organization (CSIRO) and Bureau of Meteorology (BOM), Australia	CSIRO-BOM	ACCESS1.0
Beijing Climate Center, China Meteorological Administration	BCC	BCC-CSM1.1
Beijing Normal University	BNU	BNU-ESM
Canadian Centre for Climate Modelling and Analysis	CCCMA	CanESM2
National Center for Atmospheric Research	NCAR	CCSM4
National Center for Atmospheric Research	NCAR	CESM1/CAM5
Centre National de Recherches Meteorologiques / Centre Europeen de Recherche et Formation Avancees en Calcul Scientifique	CNRM-CERFACS	CNRM-CM5
Commonwealth Scientific and Industrial Research Organization in collaboration with Queensland Climate Change Centre of Excellence	CSIRO-QCCCE	CSIRO-Mk3.6.0
NOAA Geophysical Fluid Dynamics Laboratory	NOAA GFDL	GFDL-ESM2G GFDL-ESM2M
Institute for Numerical Mathematics	INM	INM-CM4

[3] Thrasher et. al. (2012). Hydrol. Earth Syst. Sci. .,https://hess.copernicus.org/articles/16/3309/2012/

Institut Pierre-Simon Laplace	IPSL	IPSL-CM5A-LR IPSL-CM5A-MR
Japan Agency for Marine-Earth Science and Technology, Atmosphere and Ocean Research Institute (The University of Tokyo), and National Institute for Environmental Studies	MIROC	MIROC-ESM MIROC-ESM-CHEM
Atmosphere and Ocean Research Institute (The University of Tokyo), National Institute for Environmental Studies, and Japan Agency for Marine-Earth Science and Technology	MIROC	MIROC5
Max Planck Institute for Meteorology	MPI-M	MPI-ESM-LR MPI-ESM-MR
Meteorological Research Institute	MRI	MRI-CGCM3
Norwegian Climate Centre	NCC	NorESM1-M

Annexure 3

Sectoral greenhouse gas emissions profile: Climate change drivers

3.1 About greenhouse gas emissions inventorisation

An emissions inventory that identifies and quantifies a region's primary anthropogenic sources and sinks of greenhouse gases (GHGs) is essential. It is the first step in planning the mitigation and adaptation mechanisms for climate action of that region. In order to present the baseline scenario and trends in emissions of Indore district, an emission (GHG) profile has been prepared. This exercise not only helps identify the climate change drivers but also the mitigation potential of each sector/category. A comprehensive inventory would be beneficial for the district in the following ways:

- Decision makers will get insights to create strategies and policies for emission reductions and to track the progress of those policies;
- Regulatory agencies and corporations can use the inventory to establish compliance records with allowable emission levels;
- Research institutes and local universities can develop future projections/emission models using this dataset.
- Businesses, public and other interest groups/stakeholders can use the inventory to better understand the sources and trends in emissions.

This action plan estimates greenhouse gas (GHG) emissions for Indore district using the guidelines laid down by the Intergovernmental Panel on Climate Change (IPCC)[4]. Estimates have been done for 12 categories covering three major sectors – energy, AFOLU (agriculture, forestry, and other land use) and waste – for the years 2005 to 2019[5]. Indore does not have any large-scale industries that fall under the listed Industrial Processes and Product Use (IPPU) industry categories of the IPCC Guidelines. Therefore, there are no emissions from the IPPU sector. However, energy used in industries and the corresponding emissions are reported in the energy sector.

The quality and credibility of GHG inventories rely on the integrity of the methodologies used, the completeness of reporting, and the procedures for compilation of data. As followed at the national level for preparing National Communications (NATCOMs) and biennial update reports (BURs), this action plan has also adopted the Guidelines for National Greenhouse Gas Inventories laid down by the IPCC. Mostly, the 2006 IPCC Guidelines were followed, and for a very few categories, the 1996 IPCC guidelines were referred to. Attempts have been made to estimate emissions with higher tier (from the methodological hierarchy given in the three-tier approach of IPCC Guidelines). Furthermore, wherever possible country specific emission factors (from the two NATCOMs, INCCA Report and the two BURs)[6] were used in place of default emission factors. To understand the regional dynamics and to make appropriate methodological assumptions in the absence of specific activity data/inputs, sectoral expert inputs as well as the work of Greenhouse Gas Platform India (GHGPI) and its sectoral methodology notes were also referred to.

[4] The 2006 IPCC Guidelines were followed to the extent possible; and for a very few categories the 1996 IPCC guidelines were referred. Background note on GHG Inventorisation and its significance is given in Annexure 3.1

[5] 2017, 2018 and 2019 estimates are done by applying CAGR on the latest possible GHG calculations for each category (based on availability of activity data)

[6] India's First National Communication to the UNFCCC, 2004; India's Second National Communication to the UNFCCC, 2012; Indian Network for Climate Change Assessment - INCCA's 2010 Report 'India: Greenhouse Gas Emissions 2007'; India's First Biennial Update Report to the UNFCCC, 2016; and India's Second Biennial Update Report to the UNFCCC, 2018

3.2 Category-wise activity data sources used in Indore's GHG emissions inventory

The activity data was sourced from government approved datasets for all the sectors. Emission (category wise) sources of activity data is listed in the following table.

Sector	**Category**	**Source of Activity Data**
Energy	Transport	Petroleum Planning & Analysis Cell (PPAC)
	Manufacturing Industries	
	Residential	
	Agriculture	
	Commercial	
Agriculture, Forestry and Other Land Use (AFOLU)	Crop Residue Burning	APY Statistics from Farmers' Welfare and Agricultural Development Department, Government of Madhya Pradesh
	Urea Fertilization	Fertilizer Association of India
	Enteric Fermentation	Livestock Census of India-19th (2012); 18th (2007); and 17th (2003)
	Forest Removals	State of Forest Report-2019; 2017; 2015; 2013; 2011; 2009; 2005; 2003 by Forest Survey of India
Waste	Municipal Solid Waste	Census Data, MPPCB Annual Reports, IMC, CPCB
	Domestic Wastewater	
Carbon Footprint of Electricity Consumption	Carbon Footprint of Electricity Consumption	Madhya Pradesh Electricity Regulatory Commission

Annexure 4

Assessment of policies through the lens of climate change

4.1. Climate impact analysis of policies/programmes for power and energy sector

Policy/Scheme Name	Indicators	Calculation methodology	Emissions avoided/mitigated	Information gaps
Solar Rooftop Policy, 2012 **MP Policy for Decentralized Renewable Energy systems,2016** **Policy for the implementation of Solar based projects in Madhya Pradesh, 2012** **Madhya Pradesh Policy for Net-Metered Renewable Energy Applications, 2016**	Solar power installed capacity during the policy period.	GHG emissions mitigated = Installed capacity of solar ground/rooftop in the year of interest x Number of light days[7] x Hours of operation per day[8] x Plant Load factor of the solar plant[9] × All India grid emission factor (Net) in the year of interest[10]	**24,326 tCO_2** emissions are mitigated annually.	Year on year data is not available for Indore, since inception of the policies.
UJALA Scheme,2015	Number of LED bulbs, tube-lights and energy efficient fans distributed in the district during the period.	GHG emissions avoided = No. of LED bulbs sold in the year of interest × Difference in Wattage between incandescent and LED bulbs[11] × Annual hours of usage[12] x Net Grid emission factor	Total CO_2 Emissions avoided = **1,98,354 tCO_2e**.	Year on year data on number of UJALA LEDs distributed and number of LED streetlamps installed in the district, is not available;

[7] Number of light days considered for Solar energy, per year= 300

[8] Number of hours of operation per day= 24 hours

[9] PLF for Solar Plants =17%

[10] All India Grid Emission factor = 0.86 Kg/KwH

[11] Wattage of an incandescent bulb= 60W; Wattage of an LED bulb= 9W

[12] Annual Hours of usage= 10 x 365= 3650 hours

Policy/Scheme Name	Indicators	Calculation methodology	Emissions avoided/mitigated	Information gaps
Streetlight National Programme(SLNP)	Number of LED street bulbs installed in the district during the period.	GHG emissions avoided = No. of LED bulbs installed in the year of interest × Difference in Wattage between sodium vapor and LED bulbs[13]× Annual hours of usage[14] x Net Grid emission factor	Total CO2 Emissions avoided = **22,121 tCO_2e**.	Year on Year data since the inception of Scheme
Integrated Power Development Scheme (IPDS)/Restructured Accelerated Power Development and Reforms Programme (R-APDRP) / UDAY Scheme,2015	T&D loss during the policy period.	GHG emissions avoided= $\sum_{2015\text{-}2019}$ Electricity generation avoided with Transmission & Distribution (T & D) loss improvement in the year of interest × All India grid emission factor (net) in the year of interest	Total emissions avoided = **25,27,151 tCO_2e**.	None
PAT (Perform, Achieve and Trade) Scheme	AT&C Loss reduction during the policy period (for DISCOMS) Reduction in specific energy consumption (for other industries)	GHG emissions avoided = (Specific energy consumption (TOE) during the base year of PAT cycle- Specific energy consumption (TOE) during the assessment year of PAT cycle) x	Total emissions avoided in the district through PAT Scheme = **25,868 tCO_2e**.	None

[13] Wattage of a sodium vapor lamp= 150W to 250 W (200 W average is being used); Wattage of an LED street lamp = 70 W

[14] Annual Hours of usage= 12 x 365 = 4380 hours

Policy/Scheme Name	Indicators	Calculation methodology	Emissions avoided/mitigated	Information gaps
		(Product output (Tonnes) x Conversion factor[15] (TOE to $MtCO_2$)		
BRTS Indore	Shift in modal share of transport between before BRTS and after BRTS.	GHG Emissions avoided = ∑2011-2019 (Population × Trips × Modal share of the particular vehicular category without BRTS × EF) - (Population × Trips × Modal share the particular vehicular category with BRTS × EF)	Total emissions avoided = **4,04,000 tCO_2e**.	Latest modal share of transport is required.

[15] 1 TOE = 11630 KWh (As per International Energy Agency)

4.2. Climate impact analysis of policies/programmes for agriculture, forestry and other land use (AFOLU) sector

Policy Name	**Indicators**	**Calculation Methodology**	**Emissions Mitigated/ Added**	**Information gap, if any**
Gair Van Bhoomi par Vriksharopan Neeti	Increase in green cover due to this initiative	Add. to C-sink (t CO_2e.) = Area covered * carbon stock density*(-44/12)	Calculations could not be done due to data gap	Area brought under this scheme
Diversion of forests for non-forest purpose under the Forest Conservation Act, 1980	Loss of carbon sink due to reduction in forest area	Loss in carbon sink= Area diverted*carbon stock density*44/12	Emissions added = **1,36,542 t CO_2e added**	None
Wildlife Protection Act, 1972	Maintenance of CO_2 removals capacity of the terrestrial ecosystem	Add. to C-sink (t CO_2e) = Area covered *carbon stock density*(-44/12)	Emissions avoided = **77,040 t CO_2e avoided**	None
Cattle and Buffalo Development Improvement Programmes	Improved productivity of cross-bred cattle is likely to reduce or keep the emissions constant Assumption: Total number of indigenous and crossbreed cattle have been attributed to this policy from the year 2000	• Estimating milk produced by crossbreed cattle = number of crossbreeds *yield • Estimating number of indigenous cattle required to produce aforementioned quantity of milk • Calculating enteric fermentation emissions and manure management emissions for both crossbreed and indigenous cattle • The difference between these two emissions are the emissions added or avoided	Total emissions avoided **5,859 tonnes CO_2e**	None

Policy Name	Indicators	Calculation Methodology	Emissions Mitigated/ Added	Information gap, if any
Vats Paalan Protsahan Yojana	Improved productivity of cross-bred cattle is likely to reduce or keep the emissions constant	Total emissions= calves born*emission factor	Calculations could not be done due to data gap	Specific Number of calves born through this scheme in Indore is needed
Accelerated Fodder Development Programme	Reduction in CH_4 emission during Enteric Fermentation in Livestock	Tier-III methodology to estimate emissions from Enteric fermentation (from IPCC 2006 Guidelines)	Calculations could not be done due to data gap	1. Quantity of feed additives added to the fodder 2. Quantity of Green fodder provided to the animals 3. Details of the target population 4. Improved emission factors due to better feed intake In our opinion these gaps in information need to be plugged.
Soil Health Card Scheme	Improve the nutrient proportion of the soil in order to reduce the usage of the fertilizers	Emissions avoided= Reduction in fertilizer use (kg) *emission factor	Calculations could not be done due to data gap	The specific data inputs that are required to make such a judgment include, in our opinion: 1. Actual Area covered under the scheme 2. Actual Reduction in the fertilizer usage due to the scheme
National Food Security Mission	Impact on GHG emissions	• Emissions from nitrogen fixing	Calculations could not be done due to data gap	Data required to make

Policy Name	Indicators	Calculation Methodology	Emissions Mitigated/ Added	Information gap, if any
	from the cultivation of food crops 1. Increase in N_2O emissions due to increase in nitrogen fixing (pulses) crop production 2. Change in CO_2 Emissions due to crop residue burning and use of urea.	crops • Crop residue burning emissions • Emissions from urea used in the Fields		qualitative or quantitative judgement was not available

4.3. Climate impact analysis of policies/programmes for cross-cutting sector: Agriculture and energy

Policy Name	Indicators	Calculation Methodology	Emissions Mitigated/Avoided/Added	Information gap, if any
National Mission on Micro Irrigation	Enhancement of the water use efficiency in a sustainable manner with decline in the use of fertilizers and electricity	Total emissions avoided (tCO_2e) = scenario if micro irrigation (MI) is not in place (total urea consumption in 1 ha of land*area*EF*44/12) - Scenario if MI is in place (28% of urea saved*area*EF*44/12)	**1,407 tonnes CO_2e** avoided (due to decrease in use of fertilizer)	None
Pradhan Mantri Ujjwala Yojana	Saving firewood/forest area, hence increase in sink	Total sequestration (tCO_2e) = {new LPG connections in Indore district (i.e. no. of households)*forest area saved by one household due to reduction in fuel wood consumption*carbon stock density*(-44/12)} – {standard weight of one connection*assuming each connection books 2 LPG cylinders per year *LPG NCV*CO_2 EF}	Total emissions avoided = **9,39,397 tCO2e**	None

4.4. Climate impact analysis of policies/programmes for waste sector

Policy name	Indicators	Emission estimation methodology	Emissions added/avoided/mitigated	Information gaps
Sanitation				
Total Sanitation Campaign (*Completed: 1999-2012)*	Number of household and community/school latrines constructed	F1. Total organic waste (TOW) = (Population*BOD) *0.001*I*365; F2. CH_4= (TOW-S-R) *EF Considering Assumptions A1-A5	Annual average GHG emission of **+11,885 tCO_2e** for 273,610 IHHL latrines and **+76,671 tCO_2e** for 6,710 community/school latrines between 2006 to 2012. Emission reduction by baseline: IHHL: 43% Community latrines: 8.7%	1. Data not available at public domain from 1999 to 2005 2. District level data not available.
Nirmal Bharat Abhiyan or Clean India Campaign (C*ompleted: 2012-2014)*	Number of households and community/school latrines constructed	F1. Total organic waste (TOW) = (Population*BOD) *0.001*I*365; F2. CH_4= (TOW-S-R) *EF Considering Assumptions A2-A6	Annual average GHG emission of **+1,452 tCO_2e** for 33,425 IHHL latrines and +**1,127 tCO_2e** for 99 community/school latrines between 2012 to 2014. Emission reduction by baseline: IHHL: 43% Community latrines: 8.7%	District-level data not available.
Swachh Bharat Mission Urban *(Ongoing: 2014 - till date)*	Number of households, community and public toilets constructed	F1. Total organic waste (TOW) = (Population*BOD) *0.001*I*365; F2. CH_4= (TOW-S-R) *EF Considering Assumptions A2-A5	Annual average GHG emission of **+1,015 tCO_2e** for 23,355 IHHL latrines and **+8,752** tCO_2e for 766 community/school latrines between 2014 to 2019/20. Emission reduction by baseline: IHHL: 43% Community latrines: 8.7%	District-level data not available.

Integrated Low-Cost Sanitation Scheme (ILCS) ***(Completed: 1960-2014) with revision from 2008)***	Number of household toilets constructed and converted from dry latrines	F1. Total organic waste (TOW) = (Population*BOD) *0.001*I*365; F2. CH_4= (TOW-S-R) *EF Considering Assumptions A2-A5 & A7	Annual average GHG emission of **+43 tCO_2e** for 996 IHHL latrines between 2009 to 2014. Emission reduction by baseline: IHHL: 43%	1. Only country level cumulative data available for 1960 to 2008 (28 lakh latrines constructed) 2. District level data not available.
Swachh Bharat Mission Rural ***(Ongoing: 2014 - till date)***	Number of household toilets constructed	F1. Total organic waste (TOW) = (Population*BOD) *0.001*I*365; F2. CH_4= (TOW-S-R)*EF Considering Assumptions A2-A4	Annual average GHG emission of +**6,861 tCO_2e** for 1,57,946 IHHL latrines between 2014-2019/20. Emission reduction by baseline: IHHL: 43%	No data gap
Pradhan Mantri Awas Yojana (*Ongoing: 2015 - till date)*	Number of houses constructed (households essentially include toilet facility)	F1. Total organic waste (TOW) = (Population*BOD)*0.001* I*365; F2. CH_4= (TOW-S-R)*EF Considering Assumptions A2-A4 & A8	Annual average GHG emission of +**4,834 tCO_2e** for 13,814 IHHL latrines between 2014-2019/20. Emission reduction by baseline: IHHL: 8%	No data gap
Integrated Urban Sanitation Programme (IUSP) (Completed: 2009 -2014)	Number of household, community and public toilets constructed	F1. Total organic waste (TOW) = (Population*BOD)*0.001* I*365; F2. CH_4= (TOW-S-R)*EF Considering Assumptions A2-A4	Annual average GHG emission of +**106 tCO_2e** for 2,446 IHHL latrines and +**263 tCO_2e** for 23 community/school latrines between 2009-2014. Emission reduction by baseline: IHHL: 43% Community latrines: 8%	No data gap
Waste management				

Solid Waste Management Rules, 2016 and Amendment, 2018 **- Integrated Solid Waste Management Projects (ISWM)** **- Indore Smart City Development Corporation**	• Collection, segregation, storage, transportation, processing and disposal of municipal solid waste (MSW) • Amount of biodegradable waste processed through composting/ vermi-composting	F4. CH_4 emissions from biological treatment = $\Sigma_i(M_i \times EF_i) \times 10^{-3} - R$ Considering Assumptions A12-A13	Annual average GHG emission of -**1,26,628 tCO_2e** was avoided due to 2,30,680 tonnes of MSW treated biologically through composting	No scheme-wise data available.
Bio-medical Waste Management Rules, 2016 and Amendment, 2018	Bio-medical waste segregation, storage, collection, transport and disposal Amount of BMW (yellow waste) incinerated (captive treatment & CBWTF)	F5. CO_2 emission for the total amount of waste combusted = $\Sigma_i(SW_i \times dm_i \times FCF_i \times OF_i) \times 44/12$ Considering Assumption A14	Annual average GHG emission of -**111.83 tCO_2e** was avoided due to 2,480 tonnes of BMW treated by incineration	No data gap post 2016
Hazardous & Other Wastes (Management and Transboundary Movement) Rules 2016	Amount of hazardous waste disposed by incineration as part of hazardous waste treatment processes	Formula F5 (I = hazardous waste)	No hazardous waste TSDF (treatment, storage, disposal facility) at Indore	There is no data available for TSDFs receiving district-wise hazardous waste
Wastewater: Domestic and industrial				
National River Conservation Plan	Number of STPs constructed to reduce river pollution load	F3. Total Organic Waste, TOW (kg of BOD per year) = BOD*0.001*I*365; F2. Annual tCH4 emissions = (TOW-S-R)*EF,	Annual average GHG emission 2006-2015: +67,951 tCO_2e for 78 MLD STP capacities 2009-2015: +10,454 tCO_2e for 12 MLD STP	Scheme/Policy wise data not available

Jawaharlal Nehru National Urban Renewal Mission on Urban Infrastructure and Governance	No. of STPs created for integrated development of infrastructural services in the cities	Considering Assumptions A9-A11 (Annexure 4.4.1)	capacities Emission reduction by baseline: 4.33%	
MP Urban (ADB) Project – Indore	No. of STPs constructed for sanitation management	Formula F3 and F2	NA	Indore is a mission city but no separate data is available for STPs built under this mission
Atal Mission for Rejuvenation and Urban Transformation (AMRUT) (*Ongoing: 2015-till date*)	No. of STPs constructed for sewerage and septage management	Formula F3 & F2	NA	Indore is a mission city but no data available separately for STPs built under this mission
Common Effluent Treatment Plant (CETP) for Medium & Small-Scale industries	Industry category wise wastewater treated in different CETPs	Formula F3 & F2	NA	Industry category wise wastewater generation & treatment details not available but have the potential to improve database availability
Online Monitoring of Industrial Effluents & Emissions (OCEMS)	Industry category wise wastewater treated	Formula F3 & F2	NA	No data available in the public domain but this system hosted by CPCB has the potential to

				provide industry category wise wastewater generation, treatment and discharge information

4.5. List of assumptions for policy impact evaluation of the waste sector

Assumption No.	**Assumptions**
A1	Impact estimated for 2006-2012 wherein activity data available
A2	All new IHHLs constructed are operational and in use
A3	IHHL constructed are of two-pit pour flush type and community latrine are of septic tank type.
A4	Baseline: In the absence of IHHLs the wastewater is assumed to be discharged in water bodies (43.3%) and land (56.7%) as sourced for Gujarat
A5	No. of latrines constructed in the district were determined @ of %household share of districts to that of the state.
A6	Impact estimated for 2012-2014
A7	Impact estimated for 2009-2014
A8	IHHL constructed are of septic tank type
A9	Impact estimated for all STPs constructed and operational between 1959 to 2015 wherein aggregate activity data is available for across schemes as an STP inventory as reported
A10	Wastewater treated in aerobic system is considered to be 'not well managed/over loaded'
A11	In the absence of STPs installed the untreated wastewater is assumed to be discharged in water bodies (43.3%) and land (56.7%) as applicable for Gujarat
A12	Impact emission estimated for 2017-2018 wherein the data available for organic waste treatment
A13	Considered as a policy impact of SWM Rules 2016 for activities implemented across schemes/projects
A14	Impact emission estimated for 2016-2019 wherein the data available for hospital waste treatment by incineration

4.6. Extension of Formula F1 to F5 in the policy impact evaluation of waste sector

Extension of Formula-F1	*Population is the total number of toilet users per day, BOD per capita per day and I is the correction factor for additional industrial BOD discharged into sewers*
Extension of Formula-F2	*S = Organic component removed as sludge and R = Amount of CH_4 recovered, in the estimation year and EF = Emission Factor*
Extension of Formula-F3	*BOD = Capacity of STP (MLD)*10^6 (conversion to L)*198 mg/L (BOD of domestic waste water)*10^-3 (conversion to g/L), I = Correction factor for additional industrial BOD discharged into sewers*

Extension of Formula-F4	*Mi = mass of organic waste treated by biological treatment type; EFi = Emission factor for treatment I; i = composting or anaerobic digestion; R = total amount of CH_4 recovered in inventory year*
Extension of Formula-F5	*SWi = total amount of solid waste of type i (wet weight) incinerated or open-burned; dmi = dry matter content in the waste (wet weight) incinerated or open-burned; CFi = fraction of carbon in the dry matter (total carbon content); FCFi = fraction of fossil carbon in the total carbon; OFi = oxidation factor; i = type of waste: bio-medical waste*

Annexure 5

Budgetary analysis to estimate expenditure on climate action

5.1. Introduction to budgetary analysis

Rationale

Countries across the world have realised the need to translate their international commitments to the United Nations Framework Convention on Climate Change (UNFCCC) into national policies and action plans. They are also understanding the responsiveness of their policies to climate change as well as their impacts on ground. There is increased public scrutiny and demand for accountability to demonstrate the impacts of budgetary allocations and spending, particularly on poor and vulnerable groups. Thus, it has become extremely important to track and report financial flows that support climate change mitigation and adaptation, to build trust and accountability with respect to climate finance commitments and monitor trends and progress in climate-related investments.

Through its ambitious NDC targets and the subsequent policies rolled out to fulfil them, the Government of India has prioritised financing of climate change interventions. Owing to India's federal structure, the onus of climate change efforts falls on the state and local governments.

Therefore, an understanding of the financial flows and allocations at the state and district levels can enable a better understanding of the impact of climate action on the ground. Further, many activities that address climate change (mitigation and resilience) and are aligned with climate SDGs are already included in national and state budgets but are rarely explicitly referenced to or categorised as such. Identification of these actions can further help authorities streamline climate action at the local level.

Objectives

The primary objective of this exercise is to examine the budgetary allocations to climate change mitigation and resilience measures at the district level.

The exercise will identify on-ground climate relevant actions at the district level and analyse expenditure on climate action aimed at mitigation and resilience that also align with climate relevant Sustainable Development Goals (SDGs).

Outcomes

The analysis of budgetary allocations for climate action at the district level will:

- Help identify gaps and overlaps in the information available on district level expenditures on schemes and programmes aligned with climate action goals.
- Strengthen climate action at the district level by supporting the administration in identifying existing programmes with climate relevant activities.
- Support the development of relevant recommendations to district authorities to accelerate climate-oriented actions, such as the integration of district development plan that prioritises climate change mitigation and resilience and streamlines funds for the same.
- Improve coordination between various line departments, state, and central ministries to better manage public spending and investments, in line with the key national and state climate policy intentions.

5.2. Budgetary analysis methodology

Methodology

The methodology developed for analysis of district-level expenditure is based on the public financial management segment of 'The Climate Public Expenditure and Institutional Review (CPEIR): A methodology to review climate policy, institutions and expenditure'.

The approach, championed by UNDP, builds on the World Bank's Public Expenditure Reviews (PERs) and aims to equip policymakers with a tool to analyse the allocation of public resources, both domestic and international.

The CPEIR involves a review and analysis of three main areas with regard to climate change:

- Policy: The scope and comprehensiveness of climate policy at the national and sub-national level, within the sectors and the degree to which the policies are prioritised, costed or sequenced.
- Institutions: The institutional nexus related to climate policy delivery and the modes of cross government synchronisation, accountability and decentralisation.
- Finances: The proportion of public expenditure relevant to the distribution of it across sectors, the national/sub-national split and in some cases, proportion domestically/externally funded.

Assumptions

'Actuals' for any year are considered as actual expenditure on a particular scheme

Two kinds of relevance criteria have been considered"

- Relevance of scheme to climate mitigation or resilience, based on its ability or future ability to address climate change – by understanding the objectives and activities under each scheme – direct, indirect, marginal, and potential
- Relevance of scheme to climate mitigation and/or resilience, based on budgetary allocation within the scheme – i.e., how much of the budget under a scheme is allocated to climate relevant activities

The following steps were undertaken for review and analyse the district level expenditures:

1. **Review of available data** – exhaustive literature review was conducted to identify district-level information available from state government resources and flagship scheme portals. For missing information, respective departments or district officials were contacted to collect budget details.
2. **Sources of funds at the district level** – based on literature and inputs from district authorities, various sources of funds for the identified schemes and programmes were identified. This exercise will help in developing recommendations to improve budgetary allocation to climate action.
3. **Define boundary** – for this exercise, due to the limitations on data availability and uniformity, certain boundary conditions were applied to get a consistent analysis. The table below lists the sources referred to for each state and scheme analysed.

State/scheme	Source	Assumptions
Maharashtra (Pune, Nagpur)	Planning Department (annual district budgets)	'Actuals' in the budget considered as actual expenditure for a particular year
Gujarat (Ahmedabad, Rajkot)	**Not available yet District expenditure under schemes from respective websites	'Allocations' in the budget considered actual expenditure for a particular year
Madhya Pradesh (Bhopal, Indore)	**Not available (yet) District expenditure under schemes from respective websites	'Allocations' in the budget considered actual expenditure for a particular year

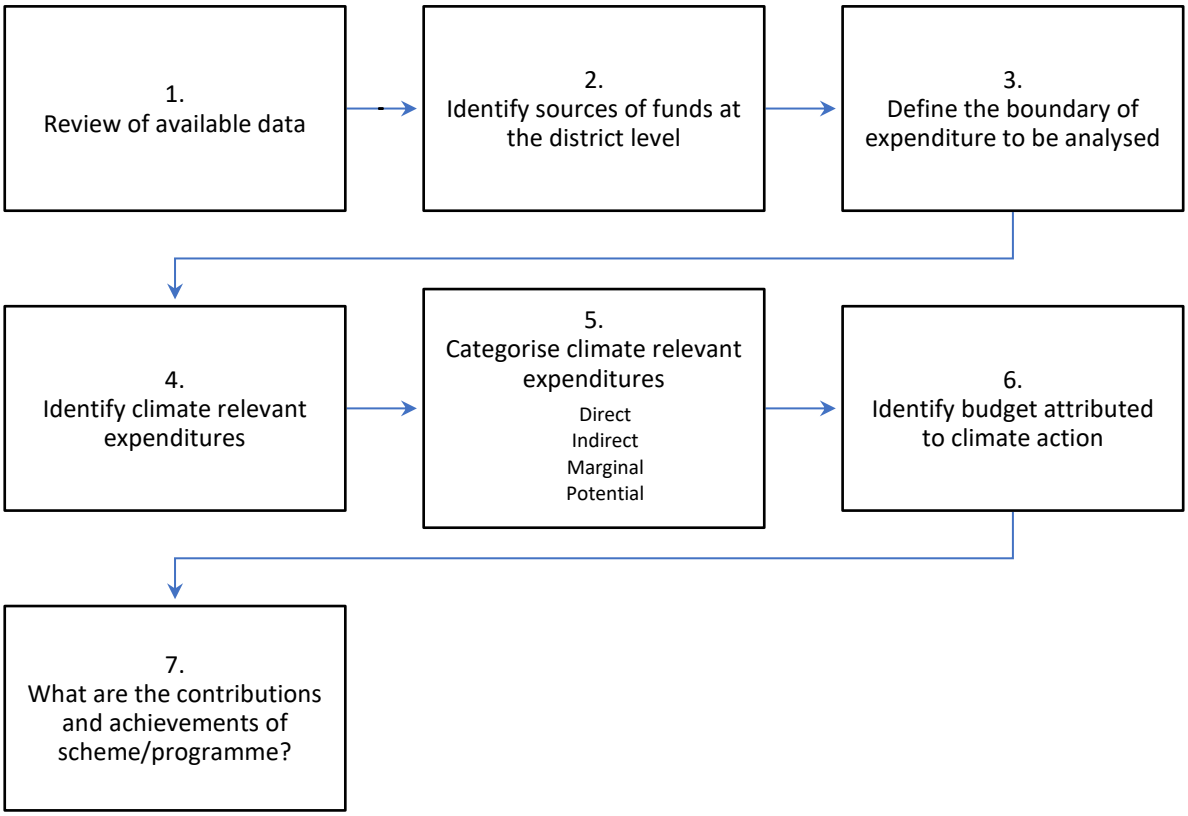

Figure 3: District expenditure review and analysis methodology

4. **Identify climate relevant expenditures** – climate relevant policies/schemes were grouped under the sectors of water, sanitation, rural and urban development, forestry, energy, and agriculture.
5. **Categorise expenditures** – the objectives and activities undertaken in the shortlisted schemes and programmes were reviewed to understand their outcomes, impacts and potential vis-à-vis climate action. Based on the extent of climate action, the categorisation criterion was chosen as shown in Table 4.
6. **Identify budget attributed** – based on the categorisation done in the previous step, an internal discussion was undertaken to assign percentage of budget attributed to climate action for each scheme. Further analysis was undertaken to understand expenditure trends.
7. **Achievements of the scheme/programme** – further, based on the impacts, the schemes and programmes were categorised under mitigation (M), resilience building (R) or both (M+R).

Table 4: Categorisation of climate actions

Category vis-à-vis climate action	**Rationale**	**% budget attributed to climate action**
Direct	Scheme and programmes whose principal objectives, activities and outcomes have direct climate resilience and mitigation implications or are aligned with climate SDGs.	70 to 100
Indirect	Schemes and programmes that have significant climate components in terms of activities and outcomes building climate resilience, climate mitigation and/or climate SDG co-benefits. However, the objectives do not have climate action as a primary objective.	35 to 69

Marginal	Schemes and programmes that have some small number of indirect climate mitigation and/or resilience co-benefits and have scope for including more climate-oriented actions.	1 to 35
Potential	Schemes and programmes that currently have no climate implication. However, they have been identified to have scope for including climate-oriented development activities in the future.	0

5.3. Analysis of schemes at the district level

A total of 39 schemes, as listed below, were reviewed to identify those with climate resilience and mitigation relevance. Of these, based on the availability of information across districts as well as relevance to climate actions, five schemes were selected for further analysis.

1	**MGNREGS**	20	Integrated Child Development Scheme (ICDS)
2	Deen Dayal Antyodaya Yojana – NRLM	21	Pradhan Mantri Ujjwala Yojana
3	Deen Dayal Upadhyaya – Grameen Kaushalya Yojana	22	Pradhan Mantri Kaushal Vikas Yojana
4	Pradhan Mantri Gram Sadak Yojana	23	Digital India – Public Internet access programme
5	National Social Assistance Programme	24	Infrastructure related programmes like telecom, railway, highways, waterways, mines etc
6	Pradhan Mantri Awas Yojana – Urban and Rural	25	Pradhan Mantri Khanij Kshetra Kalyan Yojana
7	SBM – Urban and Rural	26	Integrated Power Development Scheme
8	**PMKSY**	27	Non-Lapsable Central Pool of Resources scheme
9	Integrated Watershed Management Programme	28	RKVY
10	Digital India Land Records Modernization Programme	29	Soil Health Card
11	**Deen Dayal Upadhyay Gram Jyoti Yojana**	30	E-National Agriculture Markets
12	Shyama Prasad Mukherji National Urban Mission	**31**	**Green India Mission**
13	Heritage City Development and Augmentation Yojana	32	Accelerated Irrigation Benefit Programme
14	**AMRUT**	33	Command Area Development and water Management Programme
15	Smart Cities Mission	34	Pradhan Mantri Adarsh Gram Yojana
16	Pradhan Mantri Fasal Bima Yojana	35	Prime Minister's Employment Generation Programme
17	National Health Mission	36	Sugamya Bharat Abhiyan
18	Sarva Shiksha Abhiyan	37	Beti Bachao Beti Padhao
19	Mid-Day Meal Scheme	38	National Food Security Act
		39	Other schemes

MGNREGS

The Ministry of Rural Development (MoRD) lists 17 major categories of activities performed under MGNREGA[16]. Out of these, 11 can be attributed to be acting on climate change, categorised as mitigation specific, resilience specific or both (See Table 5).

Table 5: Categories of works under MGNREGA

S.No.	Category of Works	Type of Climate impact
1	Anganwadi/other rural infrastructure	Not Relevant
2	Bharat Nirman Rajiv Gandhi Sewa Kendra	Not Relevant
3	Food-grain	Not Relevant
4	Other works	Not Relevant
5	Playground	Not Relevant
6	Works on individual land (Category IV)	Not Relevant
7	**Coastal areas**	R
8	**Drought proofing**	R
9	**Fisheries**	R
10	**Flood control and protection**	R
11	**Land development**	R
12	**Micro irrigation works**	M+R
13	**Renovation of traditional water bodies**	M+R
14	**Rural connectivity**	R
15	**Rural drinking water**	M+R
16	**Rural sanitation**	R
17	**Water conservation and water harvesting**	M+R

Only the activities for which work has been completed or is under progress have been included in the budgetary apportioning. Since the daily wages are independent of the work being done, we can safely attribute the district budget for the year to each activity, depending on the number of works performed in the year under consideration.

- Percentage budgetary spending (on a particular activity) = (expenditure on the particular activity/state MGNREGA budget expenditure) *100
- Expenditure on a particular activity = [number of works (completed + under progress) under the activity/ total works done under MGNREGA in the district] *state budget

[16] The Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) was enacted in 2005 and seeks to improve the rural infrastructure, augment land and water resources, and strengthen the livelihood resource base of the rural poor by providing at least 100 days of guaranteed wage employment in a financial year to every household whose adult members are willing to do unskilled manual work.

PMKSY

PMKSY[17] lists number of works done (district-wise) under micro-irrigation, each year. Similarly, PMKSY also lists the number of works done in the whole state in a particular year. This can help apportion the percentage of micro-irrigation works performed in a particular district, vis-à-vis the state.

Also, since we are provided with the state budget for the micro-irrigation activities performed under PMKSY, we can derive the district budgetary spending by multiplying the state budgetary spending with the percentage calculated above. Further, based on the categorisation vis-à-vis climate action, the scheme has been identified as an 'indirect' category scheme. Although its primary objective is not climate resilience, the activities have many climate co-benefits.

- Budgetary spending on micro-irrigation activities = (number of works done in a district in a particular year/ number or works done in the state the same year) * state budgetary expenditure for the year.
- Budgetary spending that can be attributed to climate action = (budgetary spending on micro-irrigation x 0.69)
- 69% is the budget attributed for activities with indirect climate benefits

Green India Mission (GIM)

Launched in February 2014 by the Ministry of Environment, Forests and Climate Change, Green India Mission aims at increasing the green cover of a state/district under various sub-missions, as stated below:

1. Enhancing quality of forest cover and improving ecosystem service.
2. Ecosystem restoration and increase in forest cover.
3. Enhancing tree cover in urban and peri-urban areas (including institutional lands).
4. Agro-forestry and social forestry (increasing biomass and creating carbon sink).
5. Restoration of wetlands.
6. Promoting alternative fuel energy.

Since the activities performed under GIM have a direct impact on mitigation of climate change, 100 percent of budget allocated to the district can be attributed to climate action.

However, an assumption has been made while proportioning the budget to the district. GIM provides budget allocation on the basis of forest division/circle, hence the district budget has been calculated by apportioning the budget for the division/circle on the basis of the forest cover in each district falling under that particular division/circle.

[17] The major objective of PMKSY is to achieve convergence of investments in irrigation at the field level, expand cultivable area under assured irrigation, improve on-farm water use efficiency to reduce wastage of water, enhance the adoption of precision-irrigation and other water saving technologies (more crop per drop), enhance recharge of aquifers and introduce sustainable water conservation practices by exploring the feasibility of reusing treated municipal wastewater for peri-urban agriculture and attract greater private investment in precision irrigation system.

Programme architecture of PMKSY is to adopt a 'decentralise state level planning and projectised execution' structure that will allow states to draw up their own irrigation development plans based on the District Irrigation Plan (DIP) and the State Irrigation Plan (SIP).

AMRUT

The AMRUT mission has been identified as a programme that indirectly supports climate action. The activities performed under the mission can be broadly categorised into five sectors:

1. Water supply
2. Sewage and septage management
3. Stormwater drainage
4. Green space development
5. Urban transport

As per the methodology applied in the district budgetary analysis, 50 percent of the budget approved for water supply could be attributed to climate action. Similarly, the figures stand at 60 percent for sewage and septage management and 60 percent for green space development.

- Budget attributed to climate action = (approved budget for the activity x physical progress (%) x percentage allocation vis-à-vis climate action)

Deen Dayal Upadhaya Gram Jyoti Yojana (DDUGJY) and Saubhagya Scheme

Eleven major activities are carried out under DDUGJY and Saubhagya Yojana, implemented by the Ministry of Power, GOI. These are:

1. Installing new substations
2. Augmentation of existing substations
3. Installing DTRs
4. Laying LT lines
5. Installing 11KV feeders
6. Installing 33/66 KV feeders
7. Feeder segregation
8. Works done under Sansad Adarsh Gram Yojna (SAGY)
9. Consumer metering
10. DTR metering
11. Feeder metering

Out of these activities, six activities directly support climate action, hence 50 percent of the budget expended on the scheme in a particular district can be attributed to climate action.