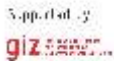


# We <sup>4</sup> Climate



**CEE**  
Centre for Environment Education



# We<sup>4</sup> Climate

The lecture series promotes a dialogue for knowledge exchange and experience sharing about climate change challenges. The participants will comprise of stakeholders including policymakers, researchers, practitioners and the general public, as well as students across four Indian states

- **Tamil Nadu**
- **Telangana**
- **Punjab**
- **Himachal Pradesh**

The lecture series is conducted by Centre for Environment Education (CEE) as part of the Indo- German bilateral project “Climate Change Adaptation in Rural Areas of India (CCA RAI)” of Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

This booklet is aimed at sharing information and creating awareness about climate change, its impacts, India's response to combat climate change and state-specific impacts.

The book is developed specially for the state of Telangana with support from Environment Protection Training and Research Institute (EPTRI).



**Environment Protection  
Training & Research Institute**

**CEE**  
Centre for Environment Education

# 1 What is Climate Change?



## Weather and Climate

**Climate change is the biggest challenge Planet Earth faces this century.**

The word climate is often interchanged with weather. Though they are related they are different in some important ways.

Weather is the day to day state of the atmosphere for a specific place, i.e. temperature, precipitation, humidity, air pressure and wind. Climate is the long-term weather pattern of a specific place. Climate means the average of the weather conditions of a place - for least over 30 years.

As for example the statement '39°C! It's hot today in Hyderabad!' describes the weather condition for the day, while the average 28.8°C mean surface temperature in



Chennai partly describes the city's climate. Another example from IPCC-2014 report, on long term changes, states that net annual temperatures in India in 2030s, with respect to 1970s, will increase by 1.7 to 2.2°C. – might refer to climate change.

**A strong anomaly of average long-term weather conditions is what we call climate change.**

*Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer).*

*Intergovernmental Panel on Climate Change*

*A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods is called as climate change.*

*United Nations Framework Convention on Climate Change*

## What causes Climate Change?

Climatic changes can take place either due to natural phenomena or human activities. The world authority on climate science, the IPCC (Intergovernmental Panel on Climate Change), is convinced that the currently observed changes are attributable to human activities, mainly the burning of fossil fuels.

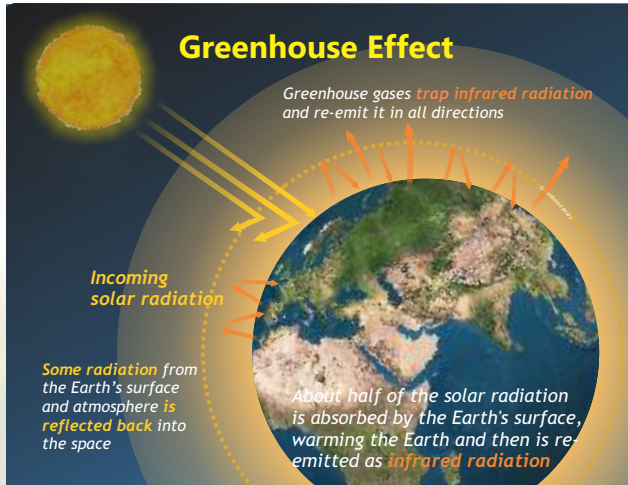
Before the industrial revolution started in the 1750s the global average surface temperature was  $14^{\circ}\text{C}$ , which has increased by  $0.85^{\circ}\text{C}$  and continues to rise due to increased release of greenhouse gases in the atmosphere.



## Why is the Globe warming up?

Some of the gases in the Earth's atmosphere can trap heat and maintain the Earth's temperature, acting as a thermal blanket. These gases, namely, Carbon Dioxide ( $\text{CO}_2$ ), Methane ( $\text{CH}_4$ ) and Nitrous Oxide ( $\text{N}_2\text{O}$ ) are called **Greenhouse Gases** (GHGs) and their effect is called **Greenhouse Effect**.

However, the concentration of the naturally present greenhouse gases in the atmosphere is increasing and new gases are being added, which leads to more heat being retained in the atmosphere. The result is the warming of our atmosphere. This is known as **enhanced greenhouse gas effect**, which is causing the global average temperature to rise.

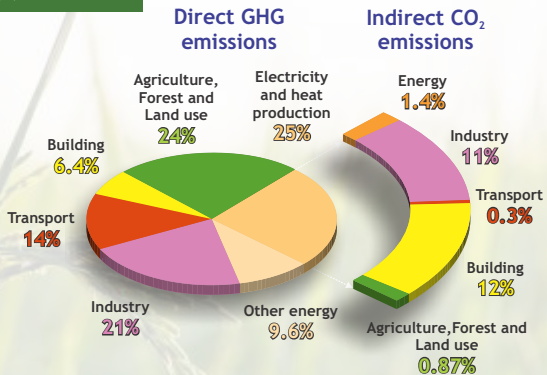


## Why is the Concentration Of GHGs Increasing?

The earth's climate had been changing due to natural causes since ages. However, the current change is **human-made**.

Since the industrial revolution, the concentration of greenhouse gases (mainly CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O) in the atmosphere has increased due to various human activities such as burning of fossil fuel for energy generation, industrial processes and transportation; deforestation and agriculture practices etc. Moreover, new gases like HFCs, PFCs and SF<sub>6</sub>, used in refrigeration and air conditioning, have been added. With urbanisation, population growth and fancier lifestyles greenhouse gas emissions have reached unprecedented levels.

Emissions in 2010  
**49 Gt CO<sub>2</sub>-eq**  
1 Gigaton (Gt) = 100 crore tonnes



Source- Synthesis Report, IPCC Fifth Assessment Report (AR5)



# Where do the global greenhouse gas emissions come from?

Transportation  
14%



Energy  
35%



Buildings  
6.4%



Industry  
21%



Agriculture and Forestry  
24%



Waste



## The Temperature Limits

**Scientific evidences and political goal suggest that in order to avoid irreversible damage, the planetary warming should be restricted to below 2°C and efforts should be undertaken to limit it to 1.5°C compared to pre-industrial levels.**

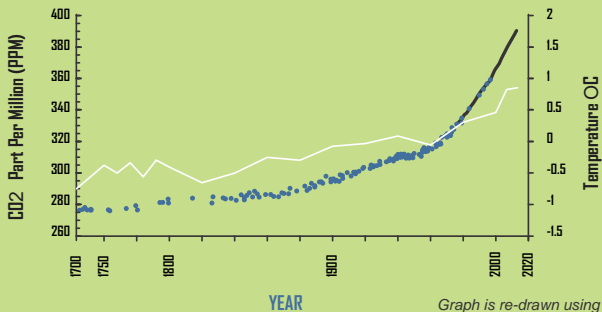
**Paris Agreement, 2015**

### **CO<sub>2</sub>: The main culprit**

Carbon dioxide acts as a thermostat regulating the temperature of Earth. Since industrial revolution, the concentration of CO<sub>2</sub> in the atmosphere has increased from 278 to 400 PPM. It accounted for 78% of the total GHG emissions from 1970 to 2010.

The other greenhouse gases, if emitted in the equal quantity as CO<sub>2</sub>, are more potent and have higher warming potential. However, the amount of CO<sub>2</sub> emitted is much higher and it remains in the atmosphere for thousands of years.

### **CO<sub>2</sub> and Temperature Rise: Correlation**



Graph is re-drawn using IPCC and NOAA data

Source: IPCC Fifth Assessment Report (AR5), Working Group I and NOAA

## 2 Impacts of Climate Change



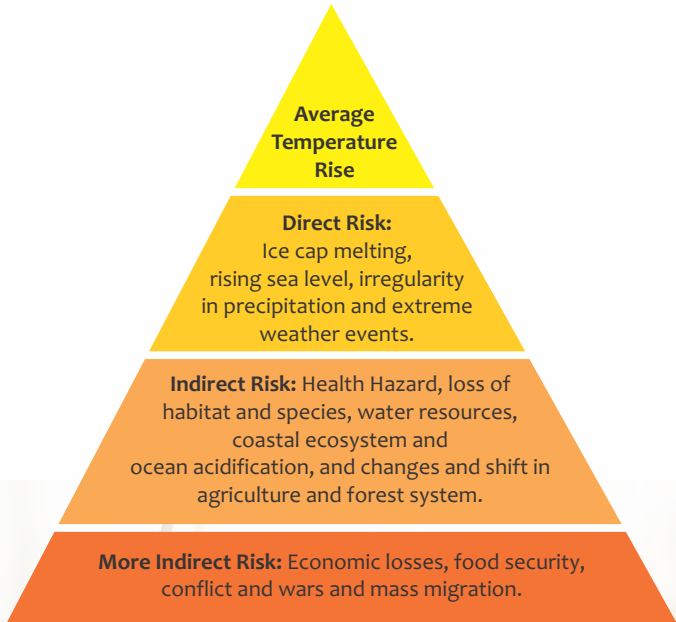
The impacts of climate change are already visible.

The average surface temperature increase is causing the polar ice cap to melt with subsequent increase in the sea level rise. However, these are the primary and direct impacts and their onset is slow.

The immediate direct impacts are the increase in extreme weather conditions and irregularity in precipitation which has indirect impacts on health, agriculture and water resources. At other levels are the indirect impacts such as migration, economic losses and increase in conflicts.

In other words impacts of climate change are cascading in nature – change as a trigger in one of the systems will alter and impact all the associated ecosystems and earth's elements as well as socio-economic systems.

## Cascading Impacts of Climate Change



## Observed and Possible Impacts of Climate Change for India

**High Health Risk** due to increase in heat waves, vector borne diseases and epidemics.

- Increase in number of heat wave days from about 5 to between 30 and 40 every year.
- Change in spatial and temporal pattern with increased frequency of vector borne diseases.
- Loss of life due to increased frequency and intensity of flood, drought, cyclone and others.



### Ecological degradation

- Loss of ecosystem and biodiversity.
- Increased frequency of forest fires.



## Coastal inundation, sea water ingress and loss of life due to sea level rise

- 40 million Indians will be at risk from rising sea levels by 2050.
- 14,000 sq.km of land at risk due to 1 m rise in sea level.
- Mumbai and Kolkata may go under water due to sea level rise.



## Losses due to extreme weather events

- Loss of life and infrastructure due to intense and frequent extreme weather events.
- Irregularity in energy production and industrial process



**Decreased agriculture productivity** due to variability in precipitation and temperature rise.

- Wheat, rice, maize and sorghum production may decline.
- Apple cultivation shifts to higher altitude in the Himalayas.
- Possible 1.5 per cent loss in GDP.
- Shrinkage in annual agricultural income by 20 to 25 per cent in unirrigated farmland and 15 to 18 per cent in irrigated areas.



Source- Executive summary, India, Second National Communication to the United Nation Framework Convention on Climate Change  
Climate, Climate Change, and Agriculture, India Economic Survey, 2017-18  
Down To Earth. (2017). Climate change impact on agriculture leads to 1.5 per cent loss in India's GDP. [Online]. Available at <http://www.downtoearth.org.in/news/climate-change-causes-about-1-5-per-cent-loss-in-india-s-gdp-57883>  
India water portal. [Online]. Available at <http://www.indiawaterportal.org/sites/indiawaterportal.org/files/b3climate.pdf>  
The Hindu. Business line. (2018). 14,000 sq.km. land at risk with rising sea level: Report. [Online]. Available at <https://www.thehindubusinessline.com/news/14000-sqkm-land-at-risk-with-rising-sea-level-report/article23105650.ece>

# 3 Solutions to Climate Change



## What is Mitigation? What is Adaptation?

**Mitigation:** Reducing climate change.

Actions that reduce the GHGs emissions or enhance the natural sinks of greenhouse gases in order to limit temperature rise.

**Adaptation:** Coping with the impacts of climate change.

Adjustments in ecological, social and economic systems to the observed and expected impacts of climate change.



## India's Response to Climate Change

India has devised several national and state level policies and actions to combat climate change.

India's **Nationally Determined Contribution (NDC)** sets a target to lower the GDP emissions intensity by 33 per cent to 35 per cent by 2030 compared to 2005 levels. It sets out climate action within the perspective of propagation of a healthy and sustainable lifestyle.

In 2008, Government of India introduced its first comprehensive climate policy called **National Action Plan on Climate Change (NAPCC)**. The action plan has defined strategies and programmes to address climate mitigation and adaptation through eight national missions, namely, Jawaharlal Nehru National Solar Mission, National Mission for Enhanced Energy Efficiency, National Mission on Sustainable Habitat, National Water Mission, National Mission for Sustaining the Himalayan Ecosystem, National Mission for a “Green India“, National Mission for Sustainable Agriculture, and National Mission on Strategic Knowledge for Climate Change.

Following the implementation of NAPCCs, the Government of India tasked all the state governments in 2009 to prepare their respective **State Action Plans on Climate Change (SAPCCs)**. The state level plan includes regional mapping of vulnerability, observed and projected impacts, and action plan and strategies for mitigation and adaptation. SAPCCs enrich the national climate change policies by feeding local and regional experiences, needs and solutions.

**Power of the sun:** India has an ambitious target of achieving 100 GW of solar power until 2022 under the National Solar Mission. To meet the target, 60 GW is targeted through large and medium scale grid-connected solar power plants while 40 GW is through rooftops. Until now, India has achieved around 22 GW of cumulative solar capacity. Additionally, India has shown global commitment by launching **International Solar Alliance (ISA)** to assist and help achieve the common goals of increasing the use of solar energy in a safe, convenient, affordable, equitable and sustainable manner. The ISA is a mutual cooperation among solar rich countries lying fully or partially between the tropics of Cancer and Capricorn. As of now, 65 countries have signed the ISA Framework Agreement.



# 4 State Status: Impacts and Responses to Climate Change by Telangana



## Possible impacts of climate change on Telangana

Average temperature increment during summer upto 3°C by 2080s.

Annual variation of temperature in the range of 3.9° to 4.2°C.

Highest amount of temperature variation will be observed in Mahabubnagar district (>4.1°C rise)

Southwest monsoon rainfall will vary from 2 mm/day to 14 mm/day for 2020s, 2050s and 2080s

Southwest monsoon anomalies project possible drought like situations in 2080s for districts of Mahabubnagar and Nalgonda.

Source- State Action Plan for Climate Change for Telangana State. 2016. Environment Protection Training and Research Institute (EPTRI).

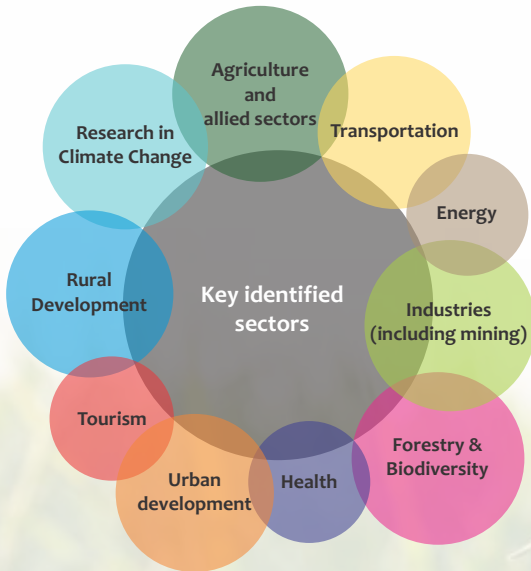


## Telangana State Action Plan on Climate Change (T-SAPCC)

Telangana State Action Plan on Climate Change has been developed in harmony with National and State level actions with largely focusing on the principles of territorial approach to climate change based on sub-national planning, building capacities for vulnerability assessment and identifying investment opportunities based on the state's priorities. Major climate change issues of the state are pertaining to agriculture and forestry sectors and in relation to the droughts and heat waves. These negative impacts of climate change has impacted state's agriculture to a great extent along with critically impacting food security, increasing number of climate vulnerable habitats and climate vulnerable infrastructure.

The **TSAPCC** thus aims at:

- Reduction of the impact of climate change on natural resources and health
- Securing household incomes particularly in agriculture
- Protecting the vulnerable populations against climate induced events
- Achieving environment sustainability through mitigation/adaptation measures.



Source- State Action Plan for Climate Change for Telangana State. 2016. Environment Protection Training and Research Institute (EPTRI).

# Case Studies

## 1. Mission Kakatiya

Mission Kakatiya is a flagship program under the Telangana government for enhancing agriculture based income of small and marginalized farmers by restoring and developing minor irrigation infrastructure through decentralized community based irrigation management. The project has helped in increasing the water storage and retention capacity of irrigation sources, and ensuring access to irrigation water to every farmer. The proposed plans were discussed with the farmers and they were encouraged to participate in the interventions of the programme that led to ownership and long-term sustainability. Moreover, measures were taken to improve soil nutritive values and soil water retention capacity by mixing silt with the soil before cultivation. This resulted in diversification and intensification of high value crops. Other achievements of the project include development of fisheries and livestock and increase in groundwater levels.



Source- Mission Kakatiya. (2017). Mission Kakatiya. [online] Available at: <https://missionkakatiya.cgg.gov.in/homemission>. NITI Aayog. (2017). Selected Best Practices in Water Management [online] Available at: [http://www.niti.gov.in/writereaddata/files/document\\_publication/BestPractices-in-Water-Management.pdf](http://www.niti.gov.in/writereaddata/files/document_publication/BestPractices-in-Water-Management.pdf).

## 2. Resilient Agricultural Households through Adaptation to Climate Change in Mahbubnagar district

The newly developed state of Telangana is in a semi-arid zone and has a predominantly hot and dry climate which gets further aggravated due to the changing climate. This project, sanctioned under the National Adaptation Fund for Climate Change, aims to enhance the livelihoods of the farming community in certain villages of Mahabubnagar district by implementing suitable, science-based, climate-resilient agricultural interventions. The project proposes to promote sustainable agriculture practices in the region through the adoption of activities such as soil and water conservation, water conservation through efficient and assured irrigation practices, developing climate-resilient cropping patterns, developing forecasting models and disseminating knowledge experience to the wider population. The project is expected to benefit more than 2000 farming households of the district, particularly small and marginal farmers, of which 30-50% of the beneficiaries will be women.



Source- weADAPT. (2017). Resilient Agricultural Households through Adaptation to Climate Change in Mahbubnagar district, Telangana. [online] Available at: <https://www.weadapt.org/placemarks/maps/view/24931>.



### 3. Root Zone Watering by System of Water for Agriculture Rejuvenation

Droughts and dry spells are a common occurrence in the state of Telangana. To encourage zero wastage of water and use optimal irrigation water, the Centre for Environment Concerns (CEC), Hyderabad, have introduced an innovative irrigation technology called System of Water for Agriculture Rejuvenation (SWAR). The system used information about the soil type, plant species and age to determine the optimal water required for the plant. The system involves harvesting and storing rainwater in overhead tanks which is sent to customised locally-made clay-pots and from there transmitted directly to the root-zone area to maintain the necessary soil moisture for the plant. Not only does this help conserve and optimize water use but it also encourages rainwater harvesting. The system is suitable for tree plantation, vegetables and fruit cultivation. In certain cases where SWAR was used for plants that were planted close to one another, it was observed that the system used one eighth of the water compared to drip irrigation.



Source- NITI Aayog. (2017). Selected Best Practices in Water Management [online] Available at: [http://www.niti.gov.in/writereaddata/files/document\\_publication/BestPractices-in-Water-Management.pdf](http://www.niti.gov.in/writereaddata/files/document_publication/BestPractices-in-Water-Management.pdf).



#### **4. Farmer Participatory Integrated Watershed Management Project in Kothapally**

Kothapally, a semi-arid agrarian region in the state, spreads over 465 ha of farmland, faces acute water scarcity and inefficient rainwater utilization. The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in partnership with a consortium of private and public organizations and local farmers, initiated a unique participatory watershed management project in the village in early 1990s.

Local knowledge and community participation in project design, implementation, monitoring and evaluation formed the crux of this project. The project adopted a farmer-centric integrated watershed management approach for sustainable water and agriculture management, and for diversifying livelihoods of marginalized and landless farmers.



More than 250 rainwater harvesting and groundwater recharge structures such as check-dams, mini percolation pits, sunken pits and gully plugs were created. Mean rise in the groundwater table between 2-4 meters, increase in the vegetation cover from 129 ha to 200 ha, and increase in average net incomes by 21 percent were observed in the project area. Additionally, 2000 farmers and other stakeholders were trained on integrated watershed management.

*Source- Council on Energy, Environment and Water (CEEW). (2015). Agri-Water Sustainability in India: Setting the Agenda for the Alliance for Thought Leadership and Action. New Delhi, p.37.*

## 5. Geothermal energy in Telangana

Geothermal energy is thermal energy stored in rocks and fluids beneath the Earth's crust, which can be tapped for electricity generation. The Godavari geothermal province in Telangana has an estimated potential for around 1500 MW power generation, based on a techno-economic report by M/s Geo Syndicate Power Pvt. Ltd. A 25 MW capacity geothermal power project is sanctioned to M/s. Geo Syndicate Power Pvt.Ltd, Mumbai, to be set up near Ashwaraopet, Khammam district. Additional six proposals totalling to 135 MW capacity of geothermal power projects have been considered for sanction.



*Source- Telangana State Renewable Energy Development Corporation Ltd. (2018). Geothermal Energy. [online] Tsredco.telangana.gov.in. Available at: <http://tsredco.telangana.gov.in/GeoThermalEnergy.aspx>.*

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Fossil Fuel Gives Way To Solar Power. 2013. Gerry Machen. CC BY-ND 2.0. Flickr Creative Commons.

Chennai weather. 2013. Sriram Jagannathan. CC-BY-2.0. Wikimedia Commons.

Kids swimming in duck pond India Gate. 2009. Brian Gratwicke. CC BY 2.0. Flickr Creative Commons.

Forest fire in Chir Pine forests near Chitai, Almora District, Uttarakhand. 2016. Ramwik. CC BY-SA 3.0. Wikimedia Commons.

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Udumalpet windmill farm landscape farms rural Tamil Nadu India. 2011. Thangaraj Kumaravel. CC BY 2.0. Flickr. Wikimedia Commons.

A frame-filling portrait of a male polar bear (*Ursus maritimus*) jumping in the pack ice. Svalbard, Norway. 2011. Bering Land Bridge National Preserve. CC BY 2.0. Flickr. Wikimedia Commons.

Pakhal Lake Telangana. 2009. Aloh Bennett. CC BY 2.0. Wikimedia Commons.

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Nagarjuna Sagar Left Canal. 2006. Sumanthk. Public Domain. Wikimedia Commons.

Farmer in Andhra Pradesh. 2008. Serge Birtel. Permission sought.

A pot irrigation for bean. 2011. Thamizhparithi Maari. CC BY-SA 3.0. Wikimedia Commons.

Check dam Thadayana. 2017. Vijayanrajapuram. CC BY-SA 4.0. Wikimedia Commons.

The Nesjavellir Geothermal Power Station. 2006. Gretar Ívarsson. Public Domain. Wikimedia Commons.



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Forest and Climate Change, Government of India