

Climate change and its effect on Agriculture

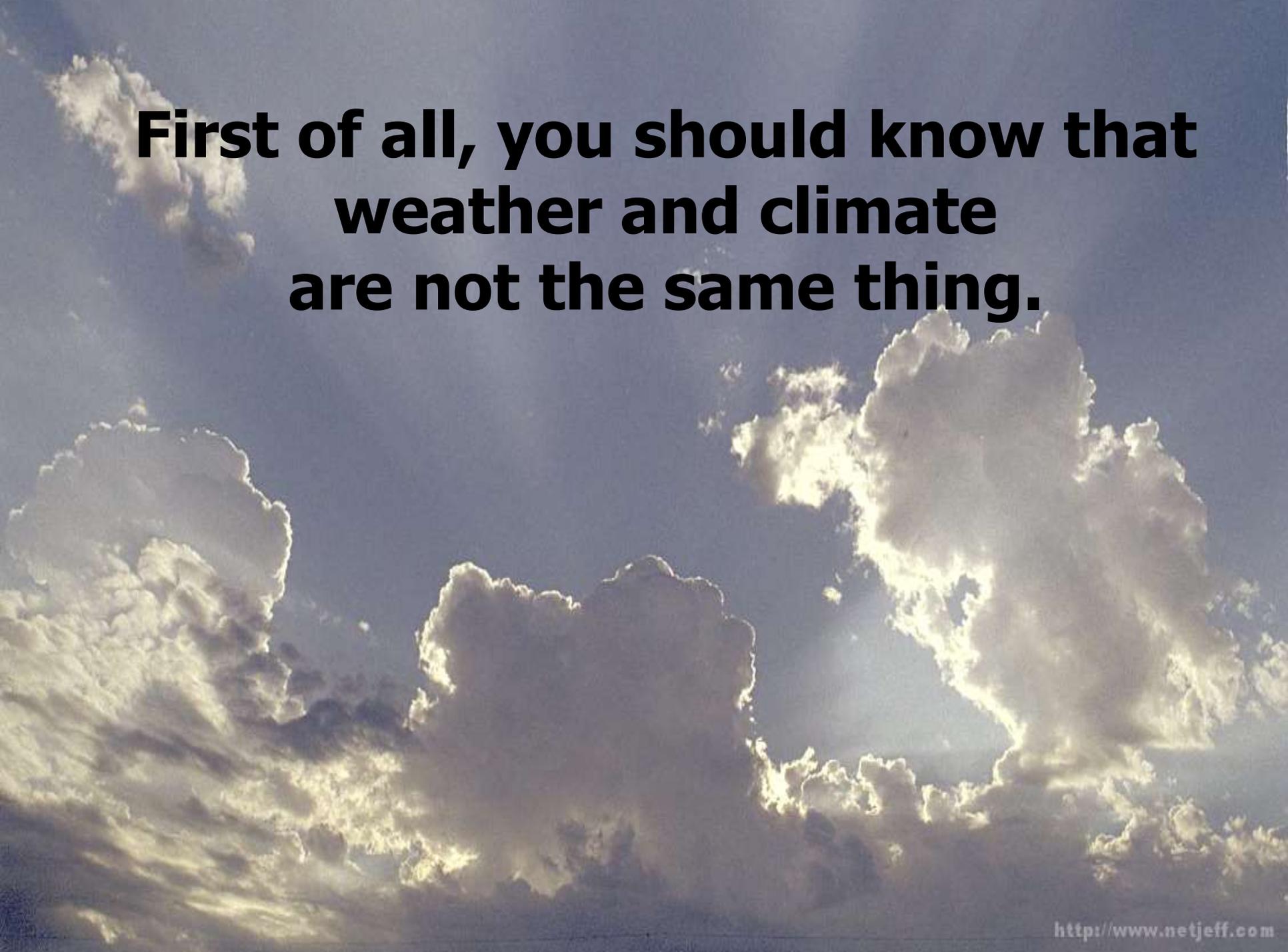
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Climate Change : Impacts on Indian Agriculture

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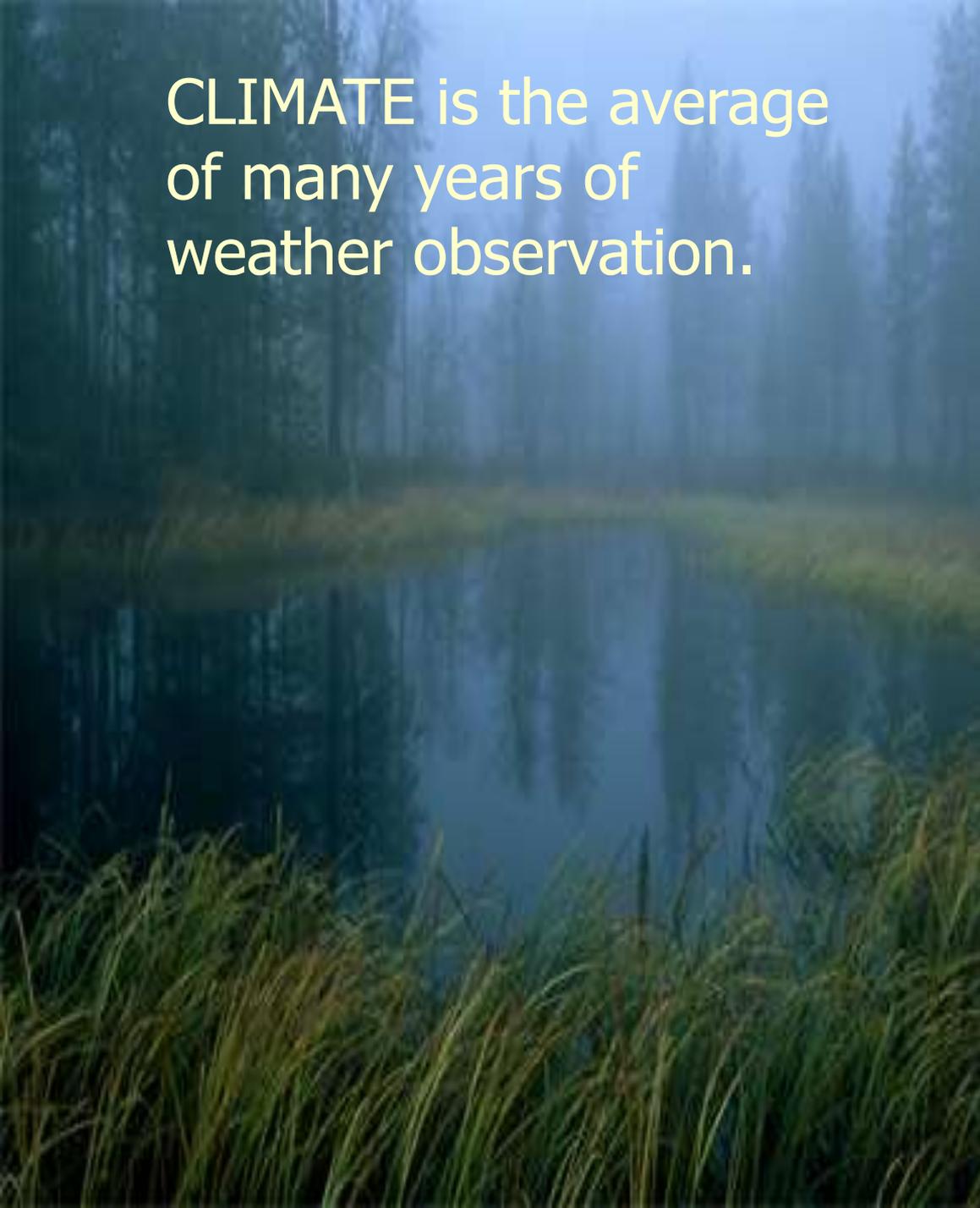
**First of all, you should know that
weather and climate
are not the same thing.**

WEATHER IS:

- Short term
- Limited area
- Can change rapidly
- Difficult to predict



WEATHER is what's
happening outside your
window right now.

A misty forest scene with a body of water and tall grasses in the foreground. The text is overlaid on the top left of the image.

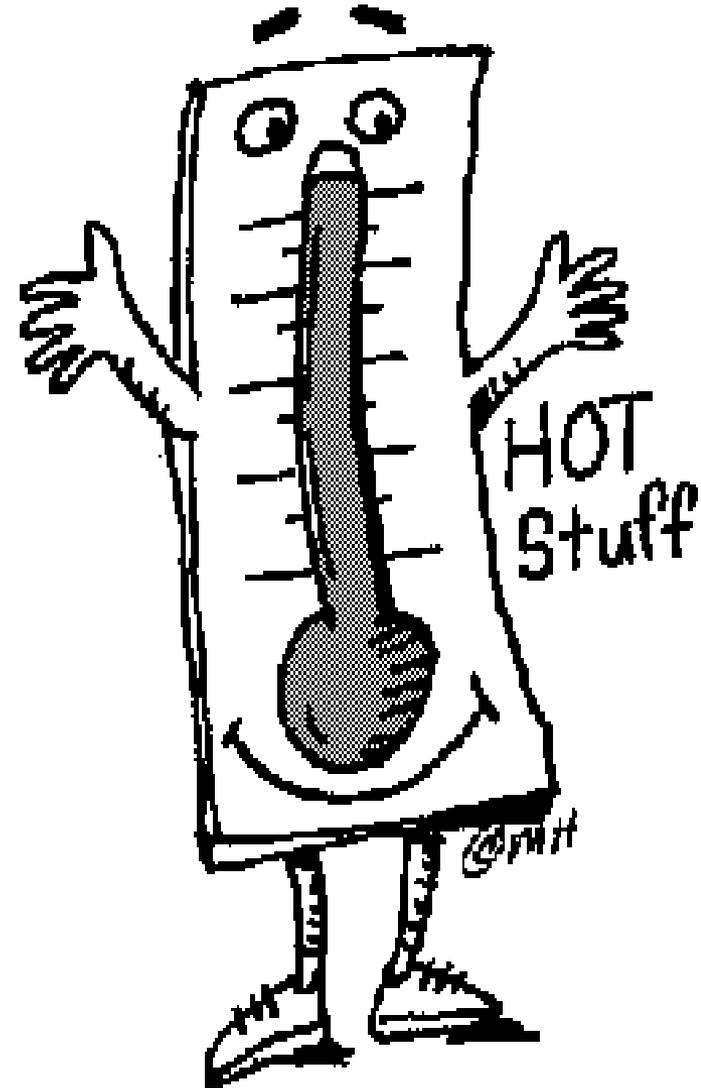
CLIMATE is the average
of many years of
weather observation.

CLIMATE IS:

- Long term
- Wide area
- Seasonal changes
- Measured over long spans of time

Global Climate Change

- Identifiable change in the climate of Earth as a whole that lasts for an extended period of time (decades or longer)
 - When due to natural processes, it is usually referred to as global climate variability
 - Usually refers to changes forced by human activities that change the atmosphere



Climate is affected by many factors

ABIOTIC FACTORS:

Ocean Currents

Solar Radiation

Evaporation

Volcanic Activity

BIOTIC FACTORS:

Transpiration

Respiration

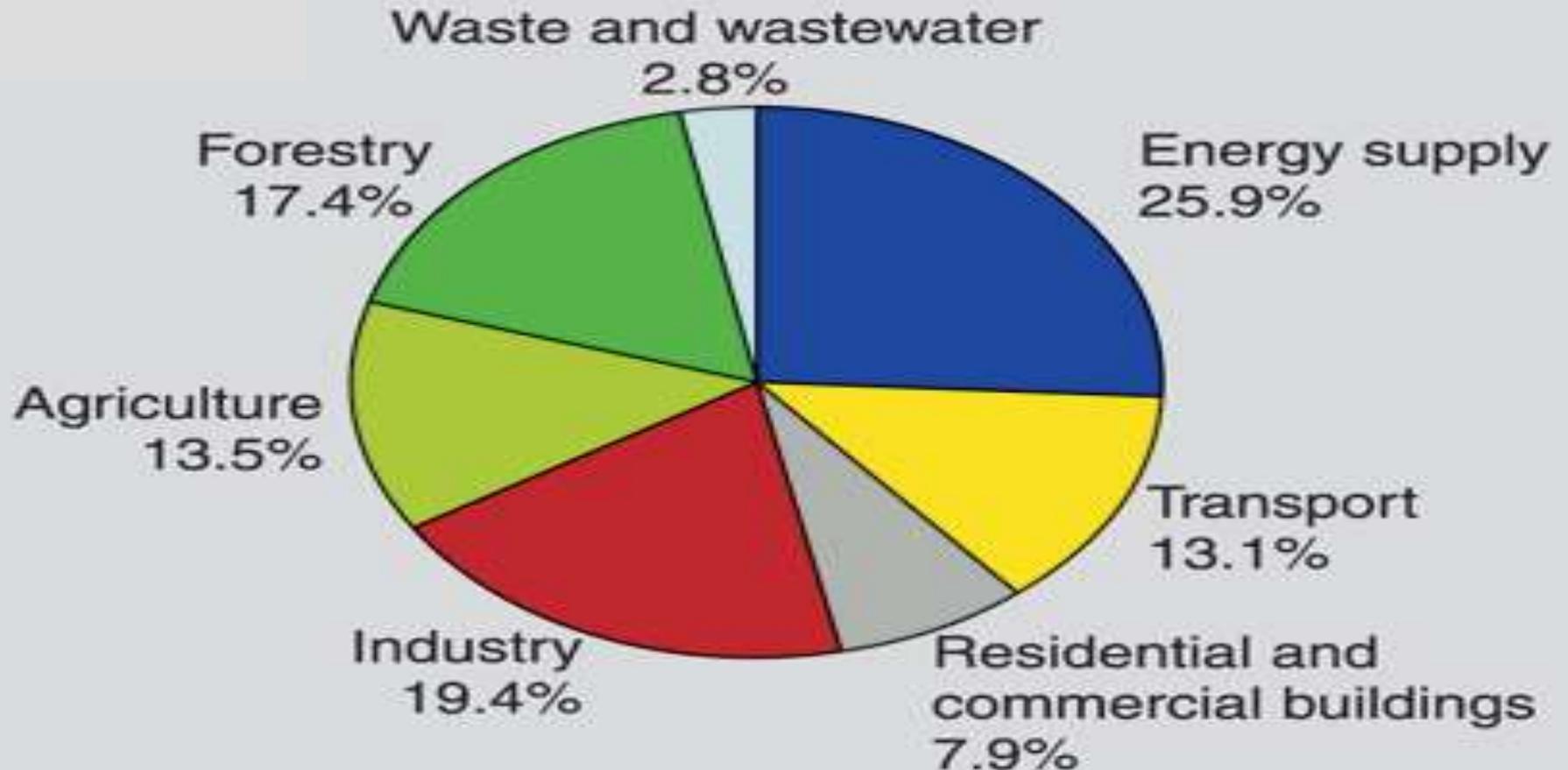
Photosynthesis

Decomposition

Some **Effects** of Climate Change

- An average increase in Earth's temperature during the last century
- Melting of polar ice—polar bears and other animals are drowning
- Migrating birds are forced to change their time and place of migration
- Melting of glaciers will lead to higher sea level, which will cause floods and put many low-elevation regions at risk of disappearing under water
- Longer summers can disrupt animal habitation
- New and widespread diseases because of warm climate
- Damaged crops due to sudden climate change and floods
- Average precipitation increase around the world
- Droughts, heat waves, extreme winters and storms, hurricanes, typhoons
- More wildfires

Contribution of different sectors in world to climate change. (Sources of Greenhouse Gas emissions)



What Is Global Warming?

- Global warming is when the earth heats up and the temperature increases
- More recently, the temperatures have been rising, causing more dangers for people, animals, plants and our environment.

The Greenhouse Effect

- The greenhouse effect is when the temperature goes up, on Earth, since the sun's heat and light energy is trapped in the earth's atmosphere.
- While the heat from the sun enters our atmosphere, the heat has trouble leaving back out our atmosphere

The Greenhouse Effect

Some of the infrared radiation passes through the atmosphere but most is absorbed and re-emitted in all directions by greenhouse gas molecules and clouds. The effect of this is to warm the Earth's surface and the lower atmosphere.

Solar radiation powers the climate system.



Some solar radiation is reflected by the Earth and the atmosphere.



ATMOSPHERE

EARTH

About half the solar radiation is absorbed by the Earth's surface and warms it.

Infrared radiation is emitted from the Earth's surface.

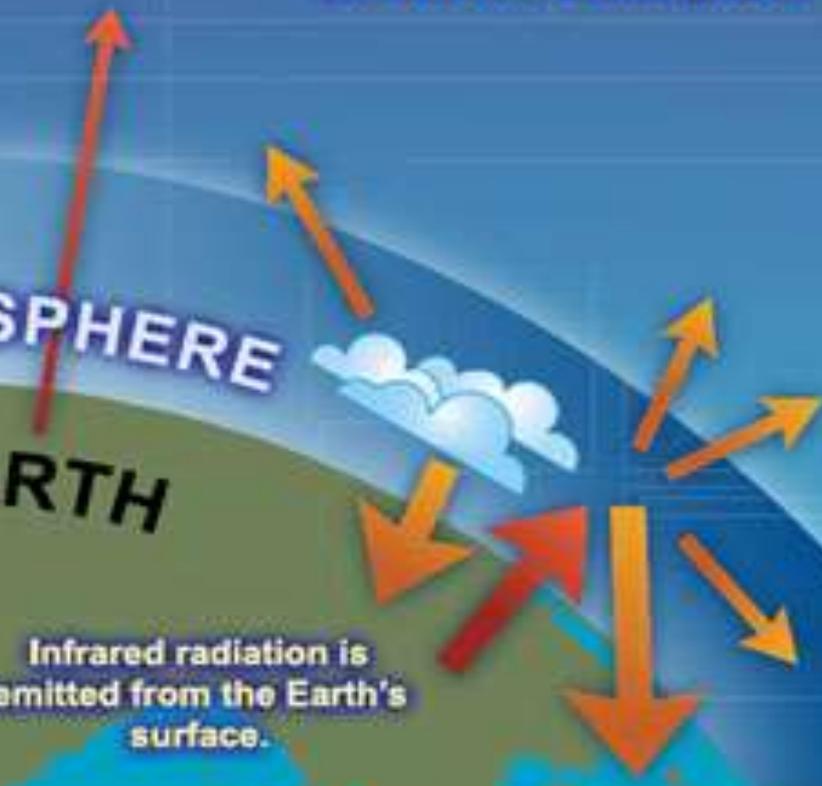
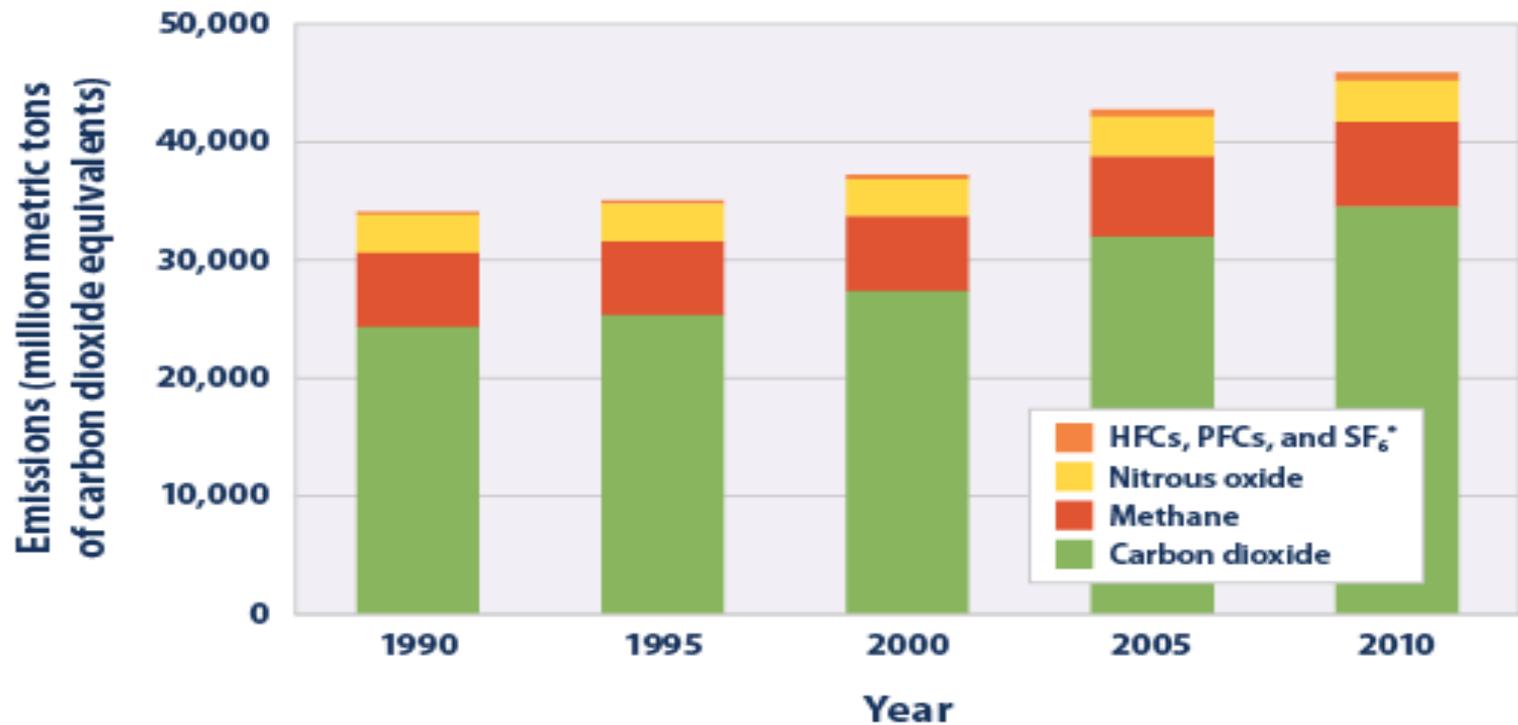


Figure 1. Global Greenhouse Gas Emissions by Gas, 1990–2010



This figure shows worldwide emissions of carbon dioxide, methane, nitrous oxide, and several fluorinated gases from 1990 to 2010. For consistency, emissions are expressed in million metric tons of carbon dioxide equivalents. These totals include emissions and sinks due to land-use change and forestry.

* HFCs are hydrofluorocarbons, PFCs are perfluorocarbons, and SF₆ is sulfur hexafluoride.

Estimates of Future Levels of CO₂

<i>Year</i>	<i>CO₂, ppm</i>
<i>2000</i>	369
<i>2010-2015</i>	388-398
<i>2050/2060</i>	463-623
<i>2100</i>	478-1099

In the coming decades, climate change and other global trends will endanger agriculture, food security, and rural livelihoods.



Agriculture & Climate Change: A three-fold relationship

I. Agriculture as a contributor to Climate Change

II. Impacts of Climate Change on Agriculture

III. Agriculture as a potential moderator of Climate Change

Food demands will rise

In order to meet global demands, we
will need

60-70%
more food

by 2050.

Current Issues in Agriculture

- **Overproduction in short-term, yet food insecurity for a large population**
- **Decline in yields**
- **Diversification**
- **Quality and quantity of water resources**

Source of 30% of total global anthropogenic emissions of GHGs

- Particulate matter & GHGs from land clearance by fire & burning of residues
- anthropogenic emissions of CH_4 and N_2O
 - CH_4 : from rice & livestock production
 - N_2O from fertilizers & manure

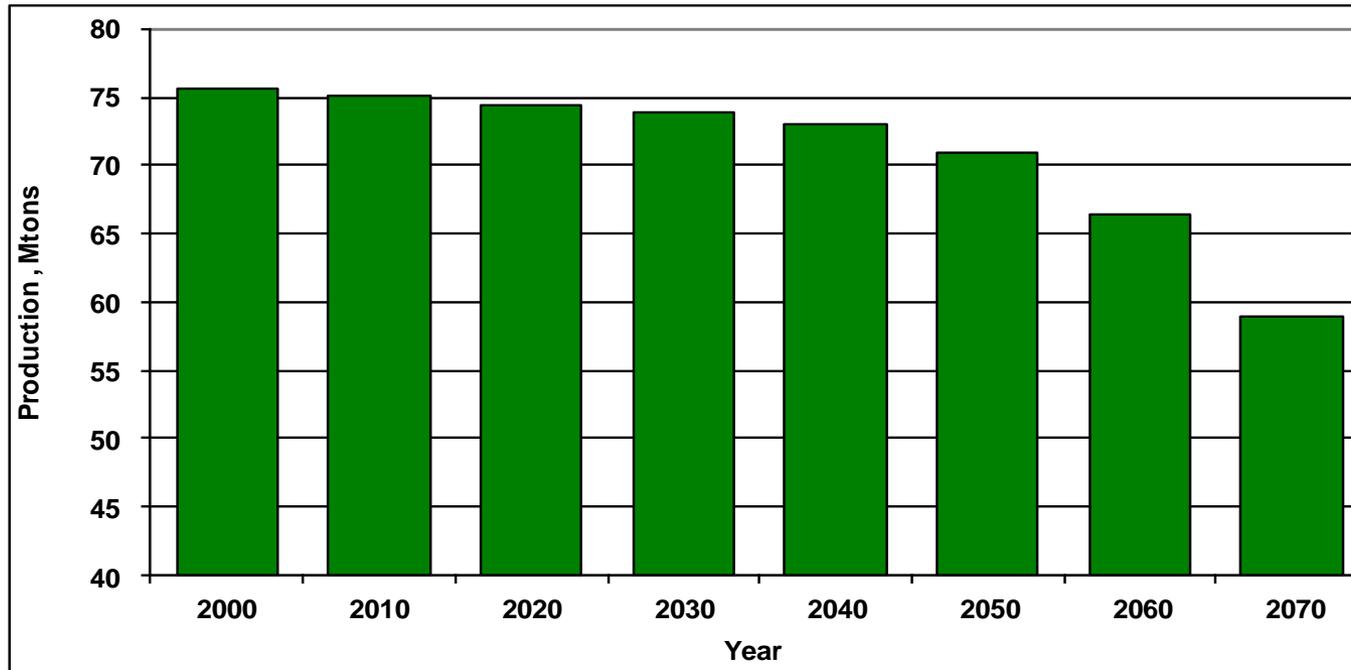
(FAO 2003, Gomiero et al. 2008)



II. Impacts of Climate Change on Agriculture

- ❑ **Greater loss expected in Rabi. Every 1°C increase in temperature reduces wheat production by 4-5 million tons. Loss only 1-2 million tons if farmers could plant in time**
- ❑ **Reduced frequency of frost damage: less damage to potato, peas, mustard**
- ❑ **Increased droughts and floods are likely to increase production variability**
- ❑ **Cereal productivity to decrease by 10-40% by 2100.**

Potential Impact of Climate Change on Wheat Production in India



Stress

- Stress in physical terms is defined as mechanical force per unit area applied to an object.
- In response to the applied stress, an object undergoes a change in the dimension , which is also known as strain.
- stress is an adverse force or a condition, which inhibits the normal functioning and well being of a biological system such as plants.
- Various types of stress are
- freezing, chilling, heat, drought, flood, salinity, etc.

How hot is too hot ?

Rising CO2 and temperature

- CO2 emitted by humans is main cause (IPCC)
- Global Surface temperatures risen – 0.8C since 1880s (IPCC),
Australian temperatures risen 0.9C since 1910 (CSIRO)

Heat stress in rice production systems

- All rice production systems will be exposed to heat stress but rainfed uplands are particularly vulnerable
- Heat stress leads to high sterility, stunting and accelerated development
- Above 33 °C sterility of rice drastically increases
- Severe yield reduction
- Grain quality (chalkiness) increases with high Temp.

Physiological reaction of plant to low temperature

- Each plant has its unique set of temperature requirement, which are optimum for its proper growth and development.
- A set of temperature conditions, which are optimum for one plant may be stressful for another plant. many plants, especially those, which are native to warm habitat, exhibit symptoms of injury when exposed to low non-freezing temperatures.

Projected impacts of climate change on Indian agriculture

- ❑ Increasing temperature would increase fertilizer requirement for the same production targets; and result in higher emissions
- ❑ Increasing sea and river water temperatures are likely to affect fish breeding, migration, and harvests. Coral reefs start declining from 2030.
- ❑ Increased water, shelter, and energy requirement for livestock; implications for milk production

Climate Variability and Climate Change- Another Driver in Agriculture

- Increase in CO₂
- Increase in temperature
- Sea level rise
- Variability and extreme events such as floods and drought

III. Agriculture as part of the solution?

Increasing carbon sequestration through land management

Rotations with cover crops, green manure

Agroforestry

Conservation tillage

- Could reduce global CO₂ emissions by 5-15%

Organic farming (but limited benefits)

- Enhances carbon storage in soil

Projected beneficial impacts of climate change on Indian agriculture

- ❑ Reduced frequency of frost damage: less damage to potato, peas, mustard
- ❑ New 'flooded' areas may become available for fisheries in coastal regions
- ❑ Other potential benefits, if any, need to be characterized

Adaptations to Climate Change

- New varieties: drought/heat resistant
- New farm management practices
- Change in land use
- Watershed management
- Agri-insurance

What can be done?

First we must admit that climate change is everyone's problem. No agency, government, or scientist can "fix it" for us. We are all in this together.

We got here because of our lifestyle. So our lifestyle has to change.

Here's what you can do...

- Reduce emissions of greenhouse gases
- Attempt to develop alternatives energies
- Allow emission to continue, but prepare for global climate changes
- Allow emissions to continue as normal and leave preparations up to individual countries
- Combine any of these ideas
- Come up with your own unique plan!

CONCLUSIONS

- Climate change is a reality
- Indian agriculture is likely to suffer losses due to heat, erratic weather, and decreased irrigation availability
- Adaptation strategies can help minimize negative impacts
- These need research, funding, and policy support
- Costs of adaptation and mitigation are unknown but likely to be high; costs of inaction could be even higher

Climate change...Is it the Beginning of the end..??

The earth is heating..So is the environment..

Now..Its Upto Us..What We can Do..??

Come Forward..

Join hands..

**Save Agriculture..to
sustain ourselves..**

Thank You