

APPOLO



STUDY CENTRE

Monsoon TEST - 9

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Monsoon 8TH Term I Unit - 2 - Weather And Climate

Introduction

- Climate is one of the basic elements in the natural environment. It affects landforms, soil types, fauna and flora. It influences man to a large extent.
- Weather and climate influence man's activities like what we eat, wear, the house in which we live and work, farming, sailing, fishing, modern transport and even our play time etc. Hence one should have knowledge about the weather and climate. So, in this chapter we are going to learn about weather and climate, its elements and how they influence our lifestyle

Weather

- Weather is the day today conditions(state) of the atmosphere at any place as regards sunshine, temperature, cloud cover, Wind fog condition, air pressure, humidity, precipitation and such other elements. It refers to short periods like a day, a week, a month or a little longer and as such the weather changes from time to time in a day and one period to the other in an year.

Earth's atmosphere is a layer of gases surrounding the planet earth and retained by the earth's gravity. It contains about 78% nitrogen, 21% oxygen, 0.97% argon, 0.03% carbon dioxide and 0.04% trace amounts of other gases and water vapour

Climate

- Climate is generally defined as the average conditions (state) of the weather of a place or a region. The average atmospheric conditions are determined by measuring the weather

elements for a long period of time which is usually for 35 years. The elements of weather and climate are the same. The climate does not change often like weather.

The word Climate is derived from the ancient Greek word "Klimo" which means "Inclination".

Controlling factors of weather and climate

- Angle of the sun's rays, the length of daytime, altitude, distribution of land and water bodies, location and direction of mountain ranges, air pressure, winds and ocean currents are the major factors which affect the weather and climate of a region.
- The earth is spherical in shape. So, the sun's rays fall unevenly on the earth's surface. The Polar regions receive slanting sun's rays. Hence there is little or no sunlight, thus there is an extreme cold winters. Vertical sun's ray's fall directly on regions around the equator, hence the climate is very hot and almost no winters. The difference in temperature makes the air and water move in currents. Warm air rises and creates more space for air beneath, while cool air settles down.

Scientific study of weather is called Meteorology and the scientific study of climate is called climatology

Elements of weather and climate

- Temperature, rainfall, pressure, humidity and wind are the major elements of weather and climate.

Temperature

- Temperature is one of the key elements of weather and climate. The earth and its atmosphere get heated from the sun through insolation. The degree of heat present in the air is termed as temperature. Apart from sun's rays, the heat in air also depends the atmospheric mass to a small extent.

Distribution of weather elements are shown by means of Isolines on maps. Isolines are those which join the places of equal values. Isolines are given different names based on the weather element they represent.

Isotherm	Equal Temperature
Isocryme	Equal Lowest mean temperature for a specified period
Isohel	Equal Sunshine
Isollobar	Equal Pressure tendency showing similar changes over a given time
Isobar	Equal atmospheric pressure
Isohyet	Equal amount of rainfall.

- Temperature varies with time due to changes in the level of radiation which reach the earth surface. This is due to motions of the earth (The rotation and revolution) and inclination of the earth's axis.
- The temperature influences the level of humidity, the process of evaporation, condensation and precipitation.
- Heat energy from solar radiation is received by the earth through three mechanisms. They are radiation, conduction and convection. The Earth's atmosphere is heated more by terrestrial radiation than insolation.

Temperature varies both horizontally and vertically. Temperature decreases with increasing height is known as Lapse rate which is 6.5 degree celsius per 1000 meters in troposphere

Factors affecting the distribution of temperature

- Latitude, altitude, nature of land, ocean currents, prevailing winds, slope, shelter and distance from the sea, natural vegetation and soil are the major factors which affect the distribution of temperature.

Measuring Temperature

- The temperature of a unit volume of air at a given time is measured in scales like Celsius, Fahrenheit, and Kelvin. Meteorologist measures the temperature by the Thermometer, Stevenson screen and minimum and maximum Thermometer. The energy received by the earth through insolation is lost by outgoing radiation. Atmosphere is mainly heated by outgoing radiation from 2 to 4pm .So the maximum temperature is recorded between 2 and 4 pm regularly and minimum temperature is recorded around 4 am before sunrise.

Mean Temperature

- The average of maximum and minimum temperatures within 24 hours is called mean daily temperature $[(87^{\circ}\text{F}+73^{\circ}\text{F})/2=80^{\circ}\text{F}]$. Diurnal range of temperature is the difference between the maximum and minimum temperatures of a day. Annual range of temperature is the difference between the highest and lowest mean monthly temperatures of a year. The distribution of temperature is shown by means of Isotherms. Isotherms are imaginary lines which connect the same temperatures of different places.

Heat zones of the earth

- The fact that the earth is spherical in shape results in different parts of the earth getting heated differently. Based on the heat received from the sun, Earth is divided into three heat zones. They are

Torrid Zone

- It is a region between the tropic of cancer and the tropic of Capricorn. This region receives the direct rays of the sun and gets the maximum heat from the sun. This zone known as the torrid or the tropical zone

Temperate zone

- This zone lies between the Tropic of cancer and the Arctic circle in the Northern Hemisphere and between the Tropic of Capricorn and the Antarctic circle in the southern Hemisphere. This zone gets the slanting rays of the sun and the angle of the sun's rays goes on decreasing towards the poles. Thus this zone experiences moderate temperature.

Frigid Zone

- The frigid zone lies between the Arctic circle and the North Pole and between the Antarctic circle and the South Pole. This region also known as Polar region. Since it receives the extremely low temperature throughout the year, these regions are covered with snow.

Highest Temperature ever recorded

- The highest temperature ever recorded on the earth is 56.7°C (134°F). It was recorded on 10th July 1913 at Greenland Ranch of Death Valley, California, USA.

Lowest Temperature ever recorded

- The lowest temperature ever recorded on the earth is -89.2°C (-128.6°F ; 184.0 K). It was recorded on 21st July, 1983 at Soviet Vostok Station in Antarctica.

Rainfall

- Rain is a liquid water in the form of droplets that have condensed from atmospheric water vapour and then become heavy enough to fall under gravity. Rain is a major component of the water cycle and is responsible for depositing most of the fresh water on the Earth. It is the source of water for all purposes. There is a close relationship between the temperature and rainfall distribution. Generally rainfall is high in the equatorial region and decreases gradually towards poles. Rainfall is measured by Rain gauge.
- The weight of air above a given area on the earth's surface is called atmospheric pressure or air pressure. The air pressure is measured by Barometer. The standard air pressure at sea level is 1013.25mb . At the earth's surface the pressure is $1.03\text{kg}/\text{sq cm}$. The variation in standard atmospheric pressure is found both

horizontally and vertically. Based on the level of pressure, it is categorised into low pressure and high pressure. Low pressure area is an area in the atmosphere where the pressure is lower than its surrounding areas. In this situation, the wind from the surroundings blow towards the centre of low pressure. High pressure is an area of atmosphere where the barometric pressure is higher than its surrounding areas. In this case, the wind from the centre of high pressure blows towards the surrounding low pressure areas. Low pressure system is marked as "L" on weather map, where as the high pressure system is marked as "H". Low pressure systems are also called as a depression and cyclones. High pressure system is called anti cyclones. Low pressure leads to cloudiness, wind, and precipitation. High pressure leads to fair and calm weather. Isobar is used to show the distribution of air pressure.

Highest pressure ever recorded.

The highest ever air pressure at sea level was recorded at Agata, Russia on 31st December, 1968. The pressure was 1083.8mb

Lowest pressure ever recorded

The lowest pressure of 870mb was recorded at Typhoon Tip, near Guam, Mariana Island in Pacific Ocean on 12th October, 1979.

- Humans are not sensitive to small variation in air pressure. But the small variations in pressure that do exist largely determine the wind and storm patterns of the earth. The distribution of atmospheric pressure is controlled by altitude, atmospheric temperature, air circulation, earth rotation, water vapour, atmospheric storms etc.

Measuring air pressure

- Meteorologist uses barometer/aneroid barometer to measure the air pressure. Barograms are used for recording continuous variation in atmospheric pressure.

Humidity

- Humidity refers to the degree of water vapour present in the atmosphere in gaseous form in particular time and place. It ranges from 0-5 percent by volume in atmosphere. Climatically it is an important constituent of the atmosphere and its quantity depends on the level of temperature. So, the level of humidity decreases towards poles from equator. Humidity is expressed in different ways.
- Specific humidity is a ratio of the water vapor content of the mixture to the total air content on a mass basis. It is expressed in grams of vapour per kilogram of air
- Absolute Humidity is the mass or weight of water vapour present per unit volume of air. It is expressed usually in grams per cubic meter of air.

- Relative humidity is a ratio between the actual amount of water vapour present in the air and the maximum amount of water vapour it can hold at a given temperature. It is expressed as a percentage.
- Generally, warm air holds more water vapour than the cold air. When relative humidity reaches 100%, the air gets saturated. In this condition the temperature is said to be at dew-point. Further cooling will condense the water vapour into the clouds and rain. Relative humidity affects human health and comfortness. Very high and very low humidity are injurious to health. It also affects the stability of different objects, buildings and electrical applications.

Measurement of Humidity

- Hygrometer is used to measure the humidity. (which comprises wet and dry bulb-plate side by side in the Stevenson screen)

With decreasing air pressure, the availability of oxygen to breathe also decreases. At very high altitudes, atmospheric pressure and available oxygen get so low that people can become sick and even die. Mountain climbers use bottled oxygen when they ascend very high peaks. They also take time to get used to the altitude as the quick move from high pressure to low pressure can cause decompression sickness. Aircraft create artificial pressure in the cabin which makes the passengers remain comfortable while flying.

Wind

- The horizontal movement of air is called wind. Vertical movement of air is said as air current. The winds move from high pressure to low pressure. Unlike other elements a wind is made up of a series of gusts and eddies which can only be felt and not seen. Winds get their name from the direction from which they blow i.e, wind blows from south west is called southwest wind.

The wind systems are broadly categorized into three as follows.

- Ø Planetary winds
- Ø Seasonal winds
- Ø Local winds

- Planetary Winds are the ones which blow almost in the same direction throughout the year. So, they are called as Permanent or planetary winds. Trade winds, Westerlies and polar easterlies are the types of prevailing winds.
- Seasonal winds are those which change their direction according to season in a year. They are called as monsoon winds. These winds blow from sea to land during summer and land to sea during winter. Local winds are the winds blow over a small area only during a particular time of a day or a short period of a year. Land and sea breezes are example of these winds.

- The Beaufort scale is a scale for measuring wind speed. It is based on observation rather than accurate measurement. It is the most widely used system to measure wind speed today. The scale was developed in 1805 by Francis Beaufort, an officer of the Royal Navy and first officially used by HMS Beagle.

Al-Balakhī, an Arab Geographer collected climatic data from the Arab travellers and prepared the First climatic Atlas of the world

Measuring wind direction and speed

- Meteorologist measures wind direction using wind vane or weather cock. Wind speed is measured by anemometer. Wind rose is a diagram used to depict the direction and periods (No. of days) of prevailing winds on map. Meteorograph or triple register is an instrument which records wind speed and direction, sunshine and precipitation. It also provides graphic representation.

Brazil has a large area where the average wind speed is low. Gabon, Congo and DR Congo in Africa, Sumatra, Indonesia and Malaysia are the least windy places on earth.

10th Full Book

Unit 2- Climate & Natural Vegetation of India

Equable climate is also called as the British climate, Which is neither too hot nor too cold

The factors affecting the climate

- Climate of India is affected by the factors of latitude, distance from the seas, monsoon wind, relief features and jet stream.

Latitude

- Latitudinally, India lies between 8°4'N and 37°6'N latitudes. The Tropic of cancer divides the country into two equal halves. The area located to the south of Tropic of cancer experiences high temperature and no severe cold season throughout the year whereas, the areas to the north of this parallel enjoys sub-tropical climate. Here, summer temperature may rise above 40°C and it is close to freezing point during winter.

Altitude

- When the altitude increases, The temperatures decreases. Temperature decreases at the rate of 6.50C for every 1000 metres of ascent. It is called normal lapse rate.
- Hence, places in the mountains are cooler than the places on the plains. That is why the places located at higher altitudes even in south India have cool climate. Ooty and several other hill stations of south India and of the Himalayan ranges like Mussourie, Shimla etc., are much cooler than the places located on the Great Plains.

Distance from the Sea

- Distance from the sea does not cause only temperature and pressure variations but also affects the amount of rainfall. A large area of India, especially the peninsular region, is not very far from the sea and this entire area has a clear maritime influence on climate. This part of the country does not have a very clearly marked winter and the temperature is equable almost throughout the year. Areas of central and north India experience much seasonal variation in temperature due to the absence of influence of seas. Here, summers are hot and winters are cold. The annual temperature at Kochi does not exceed 30°C as its location is on the coast while it is as high as 40°C at Delhi, since it is located in the interior part. Air near the coast has more moisture and greater potential to

produce precipitation. Due to this fact, the amount of rainfall at Kolkata located near the coast is 119 cm and it decreases to just 24 cm at Bikaner which is located in the interior part.

Monsoon Wind

- The most dominant factor which affects the climate of India is the monsoon winds. These are seasonal reversal winds and India remains in the influence of these winds for a considerable part of a year. Though, the sun's rays are vertical over the central part of India during the mid-June, the summer season ends in India by the end of May. It is because the onset of southwest monsoon brings down the temperature of the entire India and causes moderate to heavy rainfall in many parts of the country. Similarly, the climate of southeast India is also influenced by northeast monsoon.

Relief

- Relief of India has a great bearing on major elements of climate such as temperature, atmospheric pressure, direction of winds and the amount of rainfall. The Himalayas acts as a barrier to the freezing cold wind blows from central Asia and keep the Indian subcontinent warm. As such the north India experiences tropical climate even during winter. During southwest monsoon, areas on the western slope of the Western Ghats receive heavy rainfall. On the contrary, vast areas of Maharashtra, Karnataka, Telangana, Andhra Pradesh and Tamil nadu lie in rain shadow or leeward side of the Western Ghats receive very little rainfall. During this season, Mangalore, located on the coast gets the rainfall of about 280 cm whereas the Bengaluru located on the leeward side receives only about 50 cm rainfall.

Jet Streams

- Jet streams are the fast moving winds blowing in a narrow zone in the upper atmosphere. According to the Jet stream theory, the onset of southwest monsoon is driven by the shift of the sub tropical westerly jet from the plains of India towards the Tibetan plateau. The easterly jet streams cause tropical depressions both during southwest monsoon and retreating monsoon.

Monsoon

- The word 'monsoon' has been derived from the Arabic word 'Mausim' which means 'season'. Originally, the word 'monsoon' was used by Arab navigators several centuries ago, to describe a system of seasonal reversal of winds along the shores of the Indian Ocean, especially over the Arabian Sea. It blows from the south-west to north-east during summer and from the north-east to south-west during winter.

- Monsoons are a complex meteorological phenomenon. Meteorologists have developed a number of concepts about the origin of monsoons. According to the Dynamic concept, Monsoon wind originates due to the seasonal migration of planetary winds and pressure belts following the position of the sun. During summer solstice, the sun's rays fall vertically over the Tropic of cancer. Therefore, all the pressure and wind belts of the globe shift northwards. At this time, Inter - Tropical Convergence Zone (ITCZ) also moves northward, and a major part of Indian landmass comes under the influence of southeast trade winds. While crossing equator this wind gets deflected and takes the direction of southwest and becomes south-west monsoon. During the winter season, the pressure and wind belts shift southward, thereby establishing the north-east monsoon (trade winds) over this region. Such systematic change in the direction of planetary winds is known as monsoon.

Atacama desert is the driest place on the earth.

Seasons

The meteorologists recognize the four distinct seasons in India. They are;

- Ø Winter or cold weather season (January - February).
- Ø Pre Monsoon or summer or hot weather season (March - May).
- Ø Southwest monsoon or rainy season (June - September).
- Ø Northeast monsoon season (October - December).

Winter or cold weather season

- During this period, the vertical rays of the sun falls over tropic of capricorn which is far away from India. Hence, India receives the slanting sun's rays which results in low temperature. The cold weather season is characterized by clear skies, fine weather, light northerly winds, low humidity and large day time variations of temperature. During this season a high pressure develops over north India and a north-westerly wind blows down the Indus and Ganges valleys. In south India, the general direction of wind is from east to west. The mean temperature increases from north to south, the decrease being sharp as one moves northwards in the north-western part of the country. The mean daily minimum temperatures range from 22°C in the extreme south, to 10°C in the northern plains and 6°C in Punjab. The rain during this season generally occurs over the Western Himalayas, Tamil nadu and Kerala. Western disturbances and associated trough in westerlies are main rain bearing system in northern part of the country. The jet stream plays a dominant role in bringing these disturbances to India. These disturbances cause rainfall in Punjab, Haryana and Himachal

Pradesh, and snowfall in the hills of Jammu and Kashmir. This rainfall is very useful for the cultivation of winter wheat.

Pre Monsoon or summer or hot weather season

- During this season, the vertical rays of the sun falls over the peninsular India. Hence, there is a steady increase in temperature from south to north. It is practically hot and dry in the entire country in the initial part of this season. Weather over the land areas of the country is influenced by thunderstorms associated with rain and sometimes with hail mostly in the middle and later part. During this season, temperature starts increasing all over the country and by April, the interior parts of south India record mean daily temperatures of 30°C–35°C. Central Indian land mass becomes hot with day-time maximum temperature reaching about 40°C at many locations. Many stations in Gujarat, North Maharashtra, Rajasthan and North Madhya Pradesh exhibit high day-time and low night-time temperatures during this season.
- Because of the atmospheric pressure conditions, the winds blow from southwest to northeast direction in Arabian Sea and Bay of Bengal. They bring pre monsoon showers to the west coast during the month of May. There are few thunder showers called “Mango Showers” which helps in quick ripening of mangoes along the coast of Kerala and Karnataka. “Norwesters” or “Kalbaisakhis” are the local severe storms or violent thunderstorms associated with strong winds and rain lasting for short durations. It occurs over the eastern and north eastern parts over Bihar, West Bengal and Assam during April and May. They approach the stations from the northwesterly direction.

Southwest monsoon or Rainy Season

- The southwest monsoon is the most significant feature of the Indian climate. The onset of the southwest monsoon takes place normally over the southern tip of the country by the first week of June, advances along the Konkan coast in early June and covers the whole country by 15th July. The monsoon is influenced by global phenomenon like El Niño.
- Prior to the onset of the southwest monsoon, the temperature in north India reaches upto 46°C. The sudden approach of monsoon wind over south India with lightning and thunder is termed as the ‘break’ or ‘burst of monsoon’. It lowers the temperature of India to a large extent. The monsoon wind strikes against the southern tip of Indian land mass and gets divided into two branches. One branch starts from Arabian sea and the other from Bay of Bengal. The Arabian sea branch of southwest monsoon gives heavy rainfall to the west coast of India as it is located in the windward side of the Western Ghats. The other part which advances towards north is obstructed by Himalayan Mountains and results in heavy rainfall in north. As Aravalli Mountain is located parallel to the wind direction, Rajasthan and western part do not get much rainfall from this branch.

The wind from Bay of Bengal branch moves towards northeast India and Myanmar. This wind is trapped by a chain of mountains namely Garo, Khasi and Jaintia are mainly responsible for the heaviest rainfall caused at Mawsynram located in Meghalaya. Later on, this wind travel towards west which results in decrease in rainfall from east to west. Over all about 75% of Indian rainfall is received from this monsoon. Tamil nadu which is located in the leeward side receives only a meagre rainfall.

Post monsoon or Retreating or Northeast monsoon season

- The southwest monsoon begins to retreat from north India by the end of September due to the southward shifting pressure belts. The southwest monsoon wind returns from Indian landmass and blows towards Bay of Bengal. The coriolis force deflects this wind and makes it to blow from northeast. Hence, it is known as Northeast monsoon or Post-monsoon season. The season is associated with the establishment of the north-easterly wind system over the Indian subcontinent. Andhra Pradesh, Tamil nadu, Kerala and south interior Karnataka receive good amount of rainfall accounted for 35% of their annual total. Many parts of Tamil nadu and some parts of Andhra Pradesh and Karnataka receive rainfall during this season due to the storms forming in the Bay of Bengal. Large scale losses to life and property occur due to heavy rainfall, strong winds and storm surge in the coastal regions. The day time temperatures start falling sharply all over the country. The mean temperature over north-western parts of the country shows a decline from about 38°C in October to 28°C in November.

Mawsynram, the place which receives highest rainfall (1141 cm) in the world. It is located in Meghalaya.

Distribution of rainfall

- The average annual rainfall of India is 118 cm. However, spatial distribution of rainfall in the country is highly uneven. About 11% area receives over 200 cm of annual rainfall, 21% area receives 125 to 200 cm, 37% area receives 75 to 125 cm, 24% area gets 35 to 75 cm and 7% area gets less than 35 cm. The Western coast, Assam, South Meghalaya, Tripura, Nagaland and Arunachal Pradesh are the heavy rainfall areas which get more than 200 cm rainfall. The whole of Rajasthan, Punjab, Haryana, Western and Southwestern parts of Uttar Pradesh, Western Madhya Pradesh, the entire Deccan Trap or Plateau region east of Western Ghats except for a narrow strip along Tamil nadu coast receive a low rainfall of less than 100 cm. The rest of the areas receive a rainfall ranging between 100 and 200 cm.

12thbook
Unit 7 - Sustainable Development

- United Nations and Sustainable Development Sustainability was first featured in the principles adopted by the United Nations Conference on the Human Environment held at Stockholm on 16 June 1972. It was now realized that development needed to be sustainable – it should not only focus on economic and social matters, but also on matters related to the use of natural resources. The United Nations commissioned a group of 22 people from both developed and developing countries to identify long-term environmental strategies for the international community. This World Commission on Environment and Development (WCED), was headed by Gro Harlem Brundtland, then the Prime Minister of Norway. This commission came to be known as the Brundtland Commission, which submitted its report, entitled Our common future, to the UN in 1987.
- The Brundtland Report focused on the needs and interests of humans. It was concerned with securing a global equity for future generations by redistributing resources towards poorer nations to encourage their economic growth in order to enable all human beings to achieve their basic needs. The report highlighted the three fundamental components of sustainable development, the environment, the economy, and society, which later became known as the triple bottom line.
- The 1992 and 2002 Earth Summits held at Rio de Janeiro and Johannesburg were the United Nations Conference on Environment and Development (UNCED), a direct result of the Brundtland Commission. An important achievement of the Rio summit was an agreement on the Climate Change Convention which led to the Kyoto Protocol which you have learned about earlier.
- The United Nations Conference on Sustainable Development (UNCSD), also known as Rio 2012, Rio+20 or Earth Summit 2012 was the third and recent International conference on sustainable development. It was hosted by Brazil in Rio de Janeiro from 13 to 22 June 2012.

Concept and Goals of Sustainable Development

- In 1980 the International Union for the Conservation of Nature introduced the term "sustainable development". Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
- A primary goal of sustainable development is to achieve a reasonable and equitably distributed level of economic wellbeing that can be continued for many human generations.

Sustainable Development Goals (SDGs)

- In 1992, the UN Conference on Environment and Development published the Earth Charter, which outlined the building of a just, sustainable, and peaceful global society in the 21st century. The action plan was known as 'Agenda 21' for sustainable development.
- In September 2015, the United Nations General Assembly formally adopted the "Universal, integrated and transformative" 2030 Agenda for Sustainable Development, a set of 17 Sustainable Development Goals (SDGs). The goals are to be implemented and achieved in every country from the year 2016 to 2030.
- Countries adopted a set of goals to end poverty, protect the planet and ensure prosperity for all as part of a new sustainable development agenda. Each goal has specific targets to be achieved over the next 15 years.
- For the goals to be reached, everyone needs to do their part: governments, the private sector, civil society and people.

End poverty in all its forms everywhere

- One in five people in developing countries still live on less than \$1.90 a day, many people risk slipping back into poverty. Economic growth must be inclusive to provide sustainable jobs and promote equality.

End hunger, achieve food security and improved nutrition and promote sustainable agriculture

- Agriculture, forestry and fisheries can provide nutritious food for all and generate decent incomes, while supporting people-centred rural development and protecting the environment. A profound change of the global food and agriculture system is needed if we are to nourish today's 815 million hungry and the additional 2 billion people expected by 2050.

Ensure healthy lives and promote well-being for all at all ages

- Significant strides have been made in increasing life expectancy and reducing some of the common killers associated with child and maternal mortality. Major progress has been made on increasing access to clean water and sanitation, reducing malaria, tuberculosis, polio and the spread of HIV/AIDS.

Ensure inclusive and quality education for all and promote lifelong learning

- Major progress has been made towards increasing access to education at all levels and increasing enrolment rates in schools particularly for women and girls. For

example, the world has achieved equality in primary education between girls and boys, but few countries have achieved that target at all levels of education.

Achieve gender equality and empower all women and girls

- Gender equality is not only a fundamental human right, but a necessary foundation for a peaceful, prosperous and sustainable world.

Ensure access to water and sanitation for all

- Clean, accessible water for all is an essential part of the world we want to live in. There is sufficient fresh water on the planet to achieve this. But due to bad economics or poor infrastructure, every year millions of people, most of them children, die from diseases associated with inadequate water supply, sanitation and hygiene. By 2050, at least one in four people is likely to live in a country affected by chronic or recurring shortages of fresh water.

Ensure access to affordable, reliable, sustainable and modern energy for all

- Energy is central to nearly every major challenge and opportunity the world faces today. Sustainable energy is opportunity – it transforms lives, economies and the planet.

Promote inclusive and sustainable economic growth, employment and decent work for all

- Sustainable economic growth will require societies to create the conditions that allow people to have quality jobs that stimulate the economy while not harming the environment. Job opportunities and decent working conditions are also required for the whole working age population.

Build resilient infrastructure, promote sustainable industrialization and foster innovation

- Inclusive and sustainable industrial development is the primary source of income generation, allows for rapid and sustained increases in living standards for all people, and provides the technological solutions to environmentally sound industrialization.

Reduce inequality within and among countries

- To reduce inequality, policies should be universal in principle paying attention to the needs of disadvantaged and marginalized populations

Make cities inclusive, safe, resilient and sustainable

- Cities are hubs for ideas, commerce, culture, science, productivity, social development and much more. At their best, cities have enabled people to advance socially and economically. Common urban challenges include congestion, lack of funds to provide basic services, a shortage of adequate housing and declining infrastructure.

Ensure sustainable consumption and production patterns

- Sustainable consumption and production is about promoting resource and energy efficiency, sustainable infrastructure, and providing access to basic services, green and decent jobs and a better quality of life for all. Its implementation helps to achieve overall development plans, reduce future economic, environmental and social costs, strengthen economic competitiveness and reduce poverty.

Take urgent action to combat climate change and its impacts

- Climate change is now affecting every country on every continent. It is disrupting national economies and affecting lives, costing people, communities and countries dearly today and may be even more tomorrow.

Conserve and sustainably use the oceans, seas and marine resources

- The world's oceans – their temperature, currents and life – drive global systems that make the earth habitable for humankind. Careful management of this essential global resource is a key feature of a sustainable future.

Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss

- Forests cover 30 per cent of the Earth's surface and in addition to providing food security and shelter, forests are key to combating climate change, protecting biodiversity and the homes of the indigenous population. Thirteen million hectares of forests are being lost every year while the persistent degradation of dry lands has led to the desertification of 3.6 billion hectares.

Promote just, peaceful and inclusive societies

- This Goal is dedicated to the promotion of peaceful and inclusive societies for sustainable development, the provision of access to justice for all, and building effective, accountable institutions at all levels.

Revitalize the global partnership for sustainable development

- A successful sustainable development agenda requires partnerships between governments, the private sector and civil society. These inclusive partnerships built upon principles and values, a shared vision, and shared goals that place people and the planet at the centre, are needed at the global, regional, national and local level.

Paris Agreement

To address climate change, countries adopted the Paris Agreement at the COP21 in Paris on 12 December 2015. The Agreement entered into force shortly thereafter, on 4 November 2016. In the agreement, all countries agreed to work to limit global temperature rise to well below 2°C, and given the grave risks, to strive for 1.5°C.

Climate Change and Sustainability

- The Earth's climate has changed throughout history. In the last 650,000 years there have been several cycles of glacial and warm periods each lasting thousands or millions of years. Most of these climate changes are attributed to very small variations in earth's orbit that changes the amount of solar energy our planet receives. It is understood that at present the Earth's climate is getting warmer which is referred to as 'Global Warming'. Earth's temperature has gone up about one degree Fahrenheit in the last 100 years. This is a very small change but small changes in earth's temperature can have big effects. Some effects are already happening such as melting of glaciers, rise in the level of oceans, prolonged droughts, excessive rain and floods, etc.

Reasons for Climate change

- Burning fossil fuels emits gases into the atmosphere. Burning fossil fuel to provide energy, coupled with the effects of major transportation and deforestation causes a rapid increase in global temperatures. This can change the climate of a place.
- Effects of climate change – Scientists had predicted in the past that the result from global climate change are now occurring, loss of sea ice, accelerated sea level rise and longer, more intense heat waves.
- Temperatures will continue to rise - Experts agree that greenhouse gases which trap heat and prevent it from leaving the earth's atmosphere are mostly responsible for the temperature spike.
- Frost-free season (and growing season) will lengthen - it could actually have detrimental effects on the crops we grow. Warmer weather helps pests survive longer which can destroy crops. Rising temperatures are also expected to

contribute to a shift in areas which are agriculturally most productive and the crops that grow there.

- Changes in precipitation patterns - The contrast between wet and dry areas will increase globally. In other words, the wet areas will get wetter and the dry areas will get drier.
- More droughts and heat waves - With rising temperatures and shifting rainfall patterns, heat waves and droughts are increasing in frequency and intensity.
- Sea level rise - Scientists have determined that global sea level has been steadily rising since 1900 at a rate of at least 0.1 to 0.25 centimeter per year. Sea level can rise by two different mechanisms with respect to climate change.
- Arctic likely to become ice-free - The Arctic Ocean is expected to become essentially ice free in summer before mid-century.

UNFCCC Process for Climate Change Adaptation, On 17, May 2017: Policy makers, implementers, supporters and investors from all over the world met during the UNFCCC Bonn Climate Change Conference at the Technical Expert Meeting (TEM) on Adaptation to discuss 'Integrating climate change adaptation with the Sustainable Development Goals and the Sendai Framework for Disaster Risk Reduction.

Response to Climate Change

- There are two main responses to climate change.
- Mitigation - which addresses the root causes of climate change, by reducing greenhouse gas emissions.
- Adaptation - seeks to lower the risks posed by the consequences of climatic changes. Both approaches will be necessary to deal with the global changes that have already been set in motion.

Mitigation measures:

- It is important that we learn how to reduce climate change, and put them into practice now, before it is too late.
- Cleaner alternative energy sources: One important way to fight climate change is to reduce our reliance on and usage of fossil fuels, and depend on alternative renewable and greener sources of energy such as wind energy, solar energy, water or hydropower, biomass, and geothermal energy.

- Energy saving tips - we can adopt energy saving tips by investing in more expensive energy-saving appliances like the compact fluorescent light (CFL) bulbs, Air-conditioners, refrigerators etc. Switching off our electrical appliances when not in use.
- Green driving tips - The best strategy to reduce toxic gas emissions is definitely to reduce the use of automobiles. Use public transport, carpooling, use of electricity powered cars or two wheelers can be an alternative.
- Reduce - Reuse - Recycle practices - Reducing, reusing and recycling helps us conserve resources and energy, and reduce pollution and greenhouse gas emissions produced thereby.
- Re-forestation - The cleanest and most efficient remover of carbon dioxide from our atmosphere actually is nothing but green plants and trees. The rate at which we are cutting down our trees and forests to make way for human developments has greatly reduced the earth's ability to remove carbon dioxide from the atmosphere.
- Organic farming - Soils are an important sink for atmospheric carbon dioxide. Nevertheless, deforestation making way for conventional agriculture is increasingly depleting this sink. Sustainable and organic agriculture helps to counteract climate change by restoring soil organic matter content as well as reduce soil erosion and improve soil physical structure. Organic farming uses natural fertilizers and helps maintain crop yields.

Watershed management and its importance

- Watershed is a geographical area drained by a stream or a system connecting stream in which water from all over an area flow under gravity to a common drainage channel. A watershed system delivers water through rills, gullies and streams to a larger body of water.
- Watershed management is proper utilization of land and water resource for optimum production with minimum hazards to natural resources. It relates to soil and water conservation proper land uses, promote afforestation and sustainable farming practices, conserve farmland and pastureland, maintaining soil fertility, proper management of local water for farming, drainage, construct small dams for flood protection, improving individuals standard of living and thereby promote ecological balance.

Key steps in watershed management

- Watershed plans should first identify the characteristics of the watershed and inventory the watershed's natural resources. The first steps in watershed management planning are to:

- Ø Delineate and map the watershed's boundaries and the smaller drainage basins within the watershed.
- Ø Map and prepare an Inventory of resources in the watershed
- Ø Prepare an Inventory and map the natural and manmade drainage systems in the watershed.
- Ø Prepare an Inventory and map land use and land cover
- Ø Prepare a soil map of the watershed
- Ø Identify areas of erosion, including stream banks and construction sites.
- Ø Identify the quality of water resources in the watershed as a baseline; and
- Ø Prepare a map and Inventory of pollution sources, both point sources (such as industrial discharge pipes) and nonpoint sources (such as municipal storm water systems, failing septic systems, illicit discharges).

Watershed Management in India:

- Watershed development project in the country has been sponsored and implemented by Government of India from early 1970s onwards. Various watershed development programs like Drought Prone Area Program (DPAP), Desert Development Program (DDP), River Valley Project (RVP), National Watershed Development Project for Rain-fed Areas (NWDPRRA) and Integrated Wasteland Development Program (IWDP) were launched subsequently in various hydro-ecological regions. Entire watershed development programs primarily focused on soil conservation and rainwater harvesting during 1980s and before.

Rain Water Harvesting (RWH)

- Millions of people throughout the world do not have access to clean water for domestic purposes. In many parts of the world conventional piped water is either absent, unreliable or too expensive. One of the biggest challenges of the 21st century is to overcome the growing water shortage. Rain Water Harvesting (RWH) has thus regained its importance as a valuable alternative or supplementary water resource, along with more conventional water supply technologies. Water shortages can be relieved if rain water harvesting is practiced more widely.

Need for Rain Water Harvesting

- Ø To overcome the situation of inadequacy of water supply.
- Ø The most economical way to increase the ground water table.
- Ø To replenish the sub soil of the urban area covered with pavements.
- Ø To recharge the underground water table at places where the availability of rain water is higher or to overcome the situation of water logging.
- Ø Rain water harvesting also improves the quality of underground water through a process called dilution.
- Ø To get water for irrigation of greenbelts, farms, gardens, etc.

Rain Water Harvesting Techniques

- There are two main techniques of rain water harvestings:
- Storage of rain water on surface for future use. Recharge to ground water.
 - The storage of rain water on surface is a traditional technique and structures used were underground tanks, ponds, check dams, weirs, etc. Recharge of ground water is a new concept of rain water harvesting and the structures generally used are: Recharge pits filled with boulders, gravels, and coarse-sand, Wells, Trenches etc.

Environmental Impact Assessment

- Every country strives to progress ahead. One aspect of progress is economic development through manufacturing and trading. Every country builds industries which provide employment, serve the consumers needs and help to generate revenue. The dominant pattern of development that humankind has followed in recent decades has brought about large scale changes in the earth systems. We are already feeling the impact of these changes upon our health, livelihoods and safety. On the other hand, the fruits of development are not equally distributed. Some countries and some communities have a high standard of living, while others are not able to meet their basic needs.
- Development projects in the past were undertaken without any consideration about their environmental consequences. As a result rivers and lakes have been polluted, air pollution has reached threatening levels and pilling of domestic and industrial wastes has resulted in land degradation. Industrialization and economic growth provided material comforts but at the same time deteriorated the quality of life.

The Objective of EIA

- ∅ To identify, predict and evaluate the economic, environmental and social impact of development activities
- ∅ To provide information on the environmental consequences for decision making and
- ∅ To promote environmentally sound and sustainable development through the identification of appropriate alternatives and mitigation measures.

Steps in the EIA Process

The eight steps of the EIA process:

- Screening: First Stage of EIA, which determines whether the proposed project, requires an EIA and if it does, then the level of assessment required.
- Scoping: This stage identifies the key impacts that should be investigated. This stage also defines the time limit of the study.
- Impact analysis: This stage of EIA identifies and predicts the likely environmental and social impact of the proposed project and evaluates the significance
- Mitigation: This step in EIA recommends the actions to reduce and avoid the potential adverse environmental consequences of development activities.
- Reporting: This stage presents the result of EIA in a form of a report to the decision-making body and other interested parties.
- Review of EIA: It examines the adequacy and effectiveness of the EIA report and provides the information necessary for decision –making.
- Decision-making: It decides whether the project is rejected, approved or needs further change.
- Post monitoring: This stage comes into play once the project is commissioned. It checks to ensure that the impacts of the project do not exceed the legal standards and implementation of the mitigation measures are in the manner as described in the EIA report.

Environmental Impact Assessment in India

- EIA was introduced in India in 1978, with respect to river valley projects. On 27 January 1994, the Union Ministry of Environment and Forests (MEF), Government of India, under the Environmental (Protection) Act 1986, made Environmental Clearance (EC) mandatory for expansion or modernisation or for setting up new projects listed in Schedule 1 of the notification. Since then there have been 12 amendments made in the EIA notification of 1994. Both central and state authorities share the responsibility of EIA's development and management. EIA is now mandatory for 30 categories of projects, and these projects get Environmental Clearance (EC) only after the EIA requirements are fulfilled.
- The MoEF recently notified new EIA legislation in September 2006. The notification makes it mandatory for all projects to get environment clearance from the central government under the following categories:
 - Ø Industries
 - Ø Mining
 - Ø Thermal power plants
 - Ø River valley projects
 - Ø Infrastructure and CRZ (Coastal Regulation Zone)
 - Ø Nuclear power projects.
- However, the new legislation has entrusted the decision of clearing projects on the state government depending on the size/ capacity of the project. EIA appraises the environmental health and social implications of planned developmental projects. It thus links environment with development. The goal of EIA is to ensure environmentally safe and sustainable development.

Measures for Promotion of Sustainable Development

- As discussed earlier, the United Nations 17 Sustainable Development Goals and 169 targets are part of the 2030 Agenda for Sustainable Development adopted by 193 Member States at the UN General Assembly Summit in September 2015, and which came into effect on 1 January 2016. These goals are the result of international consultations that brought national governments and millions of citizens from across the globe together to negotiate and adopt the global path to sustainable development for the next 15 year.
- The SDGs and targets will stimulate action in the following critically important areas: poverty, hunger, education, health and well-being, education, gender

equality, water and sanitation, energy, economic growth and decent work, infrastructure, industry and innovation, reducing inequalities, sustainable cities, consumption and production, climate action, ecosystems, peace and justice, and partnership. This agenda recognises that it is not enough to focus on economic growth alone but in creating more equal societies, and a safer and more prosperous planet.

Baripada: A hamlet that conserves forest, promotes growth

Baripada, a small hamlet straddling the Maharashtra-Gujarat border, is a collective tribal wisdom which has taken it to the next level. With a population of barely 1,000, the village has not only helped conserve their forest but also meet the United Nations' sustainable development goals, benefiting everyone in the process.

The villagers conserved the forest. And, forest helped in conservation of water. Water enabled agriculture and farming. Farming brought prosperity, which in turn helped improve literacy. And, literacy broadened horizons and led us to total transformation.

Having developed dairy and poultry over the years, the villagers have also evolved a system for marketing their products. This ensured a steady flow of revenue and kept poverty at bay. The villagers share their common land with landless families to ensure 'zero hunger' and 'reduction of inequality'.

Besides, the villagers are game for any experiments involving water, land, forest conservations, biodiversity registration, biogas, solar power, building basic infrastructure through public participation. "Decisions on prohibition, tree plantation were made at the village meeting and immediately implemented. But, to restrict entry of humans and animals in the 445 hectares of village forest was a major task".

Which countries are achieving the UN Sustainable Development Goals fastest?

- The ultimate aim of the Sustainable Development Goals is to end poverty, protect the planet and ensure prosperity for everyone. Each goal has specific targets that need to be met by 2030.
- So how close are countries to meeting them? To find out, non-profit organization Bertelsmann Stiftung and the UN Sustainable Development Solutions Network have created a prototype index that measures their performance.
- Sweden leads the list, followed by Denmark and Finland. Among the G7 countries, only Germany and France can be found among the top ten performers. The United States ranks 42nd on the Index, while Russia and China rank 62nd and 71st respectively. Also in the top 20 were Canada (13th), the Czech Republic (15th) and Slovenia (17th). Asia-Pacific's top performers Japan, Singapore and Australia rounded off the list at 18th, 19th and 20th, respectively. The SDG Index underlines that despite achieving high percentages, all countries still have their work cut out to close the remaining gap.

- India ranks 116 out of 157 nations on a global index that assesses the performance of countries towards achieving the ambitious sustainable development goals (SDGs).
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