


BLOCK 4
RESPONSE STRATEGIES TO CLIMATE
CHANGE



BLOCK 4 INTRODUCTION

Climate change as science has received unprecedented attention from both scientific institutions and academia. Climate change is a global issue that requires worldwide cooperation and negotiations for developing the necessary actions to combat its effects. This requires the integration of adaptation into existing policies and processes, taking into account the broader policy objectives and wider costs and benefits. Adaptive capacity is an important element of long-term adaptation to climate change. Interest is growing in supporting vulnerable people and communities to adapt to the impacts of a changing climate. There is an increasing emphasis on integrating adaptation into current policy and development, rather than implementing measures as a standalone activity. Climate change mitigation efforts aim to reduce the magnitude of future warming. The measures used for climate change mitigation are mainly the deployment of renewable energies and new technologies, enhancing energy efficiency, and improved sustainable agricultural and consumer practices.

Response strategies for climate change will require a central role of education. Education helps people understand and address the impact of global warming, encourage change in their attitudes and behaviour and help them adapt to climate change-related trends. The education and capacity building has also attracted the attention of policymakers, environmental activists, multilateral organizations and stimulated diplomatic activities across the world. Various stakeholders need additional capacity, not only to deal with the additional challenges of climate change but also to enhance development efforts and safeguard development gains.

Climate change management at the international level consists of the 1992 United Nations Framework Convention on Climate Change (UNFCCC), the 1997 Kyoto Protocol and the decisions taken by the signatory countries under these instruments. Paris Agreement on climate change entered into force on 4th November 2016. The main features of the agreement are universal application; the principle of equity and principle of common but differentiated responsibilities and respective capabilities; and a "legally binding agreement that will apply to those states that have expressed their consent to be bound through ratification, acceptance, approval, or accession". Concerning our country, the agreement demands India to submit "national contributions" every five years; and to embark on a low carbon development pathway.

Unit 13 “Adaptation Strategies” deals with the characteristics and determinants of adaptive capacity, and the adaptive strategies against climate change.

Unit 14 “Mitigation Strategies” deals with the mitigation strategies, carbon capture and sequestration, alternate energy options and sustainable buildings.

Unit 15 “Education and Capacity Building” deals with climate change education, capacity building and the international concerns for capacity building and climate change education.

Unit 16 “Climate Change Policy” deals with Copenhagen Summit, Paris Agreement, National Action Plan on Climate Change and State’s Action Plan in India.

After studying this block, you should be able to:

- explain the adaptive strategies from the perspective of climate change;
- discuss the mitigation strategies;
- explain carbon capture and sequestration;
- discuss the alternate energy options;
- explain sustainable buildings;
- discuss climate change education;
- discuss the international concerns for capacity building and climate change education;
- explain the significance of the Kyoto Protocol and Paris Agreement on Climate Change;
- describe National Action Plan on Climate Change; and
- examine the efforts of state governments in India to address climate change-related issues.

We hope that after studying this block, you will acquire an understanding of the response strategies to climate change.

Wishing you success in this endeavour!

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UNIT 13 ADAPTIVE STRATEGIES AND CAPACITIES

Structure

- 13.1 Introduction
- 13.2 Objectives
- 13.3 From Adaptation to Adaptive Capacity
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- 13.8 Adaptation Strategies
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- 13.9 Let Us Sum Up
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13.1 INTRODUCTION

Adaptive capacity is an important element of long-term adaptation to climate change. Interest is growing in supporting vulnerable people and communities to adapt to the impacts of a changing climate. Nevertheless, the impacts that development interventions have on adaptive capacity at the local and state level remains limited. Most development interventions are not designed with a climate change adaptation strategy. There is an increasing emphasis on integrating (mainstreaming) adaptation into current policy and development, rather than implementing measures as a standalone activity. Climate change is a global issue that requires worldwide cooperation and negotiations for developing the necessary actions to combat its effects. This requires the integration of adaptation into existing policies and processes, taking into account the broader policy objectives and wider costs and benefits.

Adaptive capacity is “the property of a system to adjust its characteristics or behaviour, in order to expand its coping range under existing climate variability or future climate conditions”. In practical terms, “adaptive capacity is the ability to design and implement effective adaptation strategies, or to react to evolving hazards and stresses so as to reduce the likelihood of the occurrence and/or the magnitude of harmful outcomes resulting from climate-related hazards”. The adaptation process requires the capacity to learn from previous experiences to cope with current climate, and to apply

these lessons to cope with future climate, including surprises. In this unit, we would be discussing the characteristics and determinants of adaptive capacity, and the adaptive strategies against climate change.

13.2 OBJECTIVES

After studying this unit, you should be able to:

- explain the characteristics and determinants of adaptive capacity; and
- explain the adaptive strategies from the perspective of climate change.

13.3 FROM ADAPTATION TO ADAPTIVE CAPACITY

Capacity is a combination of all the strengths and resources available within a community, society or organization that can reduce the level of risk, or the effects of a disaster. Capacity may include physical, institutional, social or economic means as well as skilled personal or collective attributes such as leadership and management. “Adaptation in the context of human dimensions of global change usually refers to a process, action or outcome in a system (household, community, group, sector, region, country) in order for the system to better cope with, manage or adjust to some changing condition, stress, hazard, risk or opportunity. Numerous definitions of adaptation are found in climate change literature, mostly variations on a common theme” (Smit and Wandel, 2006). Adaptation is described as “adjustments in a system’s behavior and characteristics that enhance its ability to cope with external stress” or “adjustments in ecological-socio-economic systems in response to actual or expected climatic stimuli, their effects or impacts.” also in the climate context, defines adaptations as the “adjustments in individual groups and institutional behavior in order to reduce society’s vulnerability to climate.” Based on their timing, adaptations can be anticipatory or reactive, and depending on their degree of spontaneity, they can be autonomous or planned. The concepts of adaptation, adaptive capacity, vulnerability, resilience, exposure and sensitivity are interrelated and have wide application to global change science (Smit and Wandel, 2006).

The final core concept of climate change adaptation is that of capacity: ‘the ability of a system to adjust to climate change’. Adaptive capacity does not refer to short-term coping strategies but encompasses continuous and permanent change in the system. To highlight this subtle difference, the IPCC (2001) defines the “coping range” as the ‘variation in climatic stimuli that a system can absorb without producing significant impacts. As such, there is an implied limit to coping which may be well addressed within existing natural resource management. What makes adapting (the capacity to adjust) unique is that it is permanent and requires a change in the system rather than pushing the limits of the current system.

As mentioned above, the adaptive capacity is the ability of a system to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities, or to cope with the consequences (IPCC, 2001). Adaptive capacity relates to the capacity of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences (IPCC, 2014). The expression of adaptive capacity as actions that lead to adaptation can serve to enhance a system's coping capacity and increase its coping range thereby reducing its vulnerability to climate hazards. The adaptive capacity inherent in a system represents the set of resources available for adaptation, as well as the ability or capacity of that system to use these resources effectively in the pursuit of adaptation. Adaptation can be spontaneous or planned, and can be carried out in response to or in anticipation of changes in climatic conditions.

“Adaptive capacity is in line with other concepts like adaptability, coping ability, management capacity, stability, robustness. Further, the ability to undertake adaptations is influenced by managerial ability, access to financial, technological and information resources, infrastructure, the institutional environment within which adaptations occur, political influence, kinship networks, etc.” (Smit and Wandel, 2006). At the heart of any local-level adaptation intervention is the need to increase the individual or community's adaptive capacity. There is still much debate around the definition and practical applications of the term adaptive capacity. A key component of the adaptive capacity is ensuring that individuals, communities and societies are actively involved in processes of change. Importantly, this relates to changes in behaviour, as well as in resources and technological pressures associated with development.

13.4 CHARACTERIZING ADAPTIVE CAPACITY

In order to understand how adaptive capacity can be influenced at the local level, it is important to characterize it. Unfortunately, direct assessments of adaptive capacity are not feasible, and so it becomes necessary to identify the characteristics or features that influence it. Nevertheless, understandings of adaptive capacity are still very much in their infancy and there is no agreement about its characteristics and determinants at national, community or household level. The Intergovernmental Panel on Climate Change (IPCC) identifies economic wealth, technology, information and skills, infrastructure, institutions and equity as the principal determinants of adaptive capacity (IPCC, 2001), though no distinction is made between determinants at national and local level. In these social factors, in particular power relations e.g., ‘social capital’, governance structures and the role and functions of institutions have been underplayed. “The vulnerability of any system is dependent on the exposure, sensitivity of that system and the ability of the system to cope, adapt or recover from the effects of those conditions”. It must be noted that the capacity to adapt is function of resource availability,

social structure and networks, governance structure and technology. Within the society also, the vulnerability to climate change or capacity to adapt differs with individuals and groups. For instance, women are more vulnerable than the men to climate change.

There are substantial limits and barriers to adaptation. High adaptive capacity does not necessarily translate into actions that reduce vulnerability. For example, despite a high capacity to adapt to heat stress through relatively inexpensive adaptations, residents in urban areas in some parts of the world, including in European cities, continue to experience high levels of mortality. There are significant barriers to implementing adaptation. These include both the inability of natural systems to adapt to the rate and magnitude of climate change, as well as technological, financial, cognitive and behavioural, and social and cultural constraints. There are also significant knowledge gaps for adaptation as well as impediments to flows of knowledge and information relevant for adaptation decisions. New planning processes are attempting to overcome these barriers at local, regional and national levels in both developing and developed countries. For example, least-developed countries are developing National Adaptation Programmes of Action and some developed countries have established national adaptation policy frameworks.

13.5 DETERMINANTS FOR ADAPTIVE CAPACITY

The adaptive capacity is determined by a web of factors, which may be local, socio-economic and political factors. For instance, the local factors like kinship greatly influence the ability to cope up with stress. As regards the political factors, measures like state sponsored crop insurance can be great relief to the farmers' and it increases the adaptive capacity of the farmers. Adaptive capacity is dynamic as it varies with time, individuals, community and country, (Smit and Wandel, 2006). Principal determinants of adaptive capacity according to the IPCC (2001) include economic wealth, technology, information and skills, infrastructure, institutions and equity. Others include social capital and good governance as additional key components. Determinants for adaptive capacity are also depicted through the availability of resources and their distribution across the population. Research on adaptive capacity in climate change is very limited and is a key research need. However, substantial literature in other fields (economic development, sustainable development, resource management) can provide insights into the likely key determinants of adaptive capacity. These represent conditions that constrain or enhance adaptive capacity and hence the vulnerability of regions, nations and communities. Consideration of these determinants provides another pathway to the overarching goal of protecting and enhancing human health.

13.6 STRENGTHENING ADAPTIVE CAPACITY

An enabling policy and legal framework that strengthens community adaptive capacity should be able to facilitate the ability of communities to adjust to potential damage, to take advantage of opportunities, or to cope with the consequences of climate change. This would entail promoting innovation, institutions and entitlement, information and knowledge sharing, asset base development, and governance. Adaptive capacity refers to individual and or collective strength and resources that can be accessed to allow individuals and communities to reduce their vulnerability to the impact of hazards. These capacities can either prevent or mitigate the impact of a given hazard, or prepare the community to respond to the impact better (readiness).

Box 13.1: Examples of Adaptive Capacity Indicators

Often adaptive capacity is generalised without clear indicators. It is dependent on a variety of social, economic, political, technological and institutional factors: varying in weight depending on the scale of analysis. The relationship between these indicators at the national level changes when the focus turns to the community level. The Local Adaptive Capacity Framework by the Africa Climate Change Resilience Alliance (ACCRA), outlines the main determinants of adaptive capacity, which include the asset base of a community, institutions and entitlements, knowledge and information, innovation and governance (ACCRA, 2010).

Asset Base

The various financial, physical, natural, social, political and human capitals necessary to best prepare a system to respond to a changing climate. This category incorporates the importance of various capitals, often informal, non-monetary and reliant on various social networks.

Institutions and Entitlements

The ability of system to ensure equitable access and entitlement to key resources and assets is a fundamental characteristic of adaptive capacity. Given that entitlements to key resources needed to adapt can be differentiated along age, ethnicity, class, religion and gender (to name but a few), an institutional environment that allows equitable opportunities to all groups, particularly the marginal, and most vulnerable to the impacts of climate change is essential to building the capacity to adapt.

Knowledge and Information

Successful adaptation requires information and understanding of future change, knowledge around adaptation options, the ability to assess them, and the capacity to implement the most suitable interventions. In the context of climate change, it is important to ensure that systems are in place to distribute relevant information at both national and region scales.

Innovation

Innovation can be planned and high-tech. It can be autonomous, local-level initiatives that help innovate or adapt to changes to the local climate. An enabling environment that promotes and allows for experimentation and the exploration of niche solutions is required to take advantage of new opportunities and to confront challenges presented by climate change.

Governance

Informed decision-making, transparency, and prioritisation form indeed key elements of adaptive capacity.

Source: ACCRA (2010). The ACCRA Adaptive Capacity Framework.
<http://community.eldis.org/.5a284f21>

Check Your Progress 1

- Note:** i) Use the space given below for your answers.
ii) Check your answers with those given at the end of the unit.

1) What is adaptive capacity?

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2) What are the determinants of adaptive capacity?

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3) What are the indicators of adaptive capacity according to Africa Climate Change Resilience Alliance (ACCRA)?

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13.7 ADAPTATION PLANNING FOR RESILIENCE

Adaptation planning requires a long-term and system-wide perspective, accounting for uncertainty about the future. The risks from climate change arise from the interaction of socio-economic trends and climate impacts, both of which are inherently uncertain. Adaptation measures undertaken in isolation may lock-in vulnerability in the longer term, preclude the use of more cost-effective options, or increase the vulnerability of neighboring communities. Adaptation plans that do not account for uncertainty may lead to costly mistakes when projections diverge from reality. There is a need to package and sequence interventions in ways that account for systemic interactions and are robust to uncertainty. The five-step process below provides a simplified framework for how countries can use a process of iterative risk management to support flexible adaptation planning (OECD, 2015):

- “Assess risk from climate change
- Determine acceptable levels of risk
- Develop policy responses
- Implement adaptation measures
- Monitor and evaluate”

The aim of the adaptation planning process is to ensure that climate-related risks are identified, assessed and then reduced to an acceptable level. In general, it becomes increasingly technically difficult and expensive to achieve higher levels of resilience. The cost-effectiveness of adaptation and the benefits of higher levels of resilience must be balanced. Given uncertainty about the future, planning should favour the use of strategies that are flexible, that deliver co benefits and avoid lock-in. A continuous process of monitoring and evaluation can then assist with changing course in response to new information and changing circumstances

13.8 ADAPTATION STRATEGIES

Adaptive capacity encompasses coping ability and strategies, policies and measures that can expand future coping ability. Adaptive capacity is a theoretical construct because it is not possible to know with certainty whether a country will invest resources to expand its coping ability, how technology and other factors will change, or what adaptations actually will be implemented, until a perturbation or stress occurs. For example, access to clean water and adequate sanitation is part of the coping capacity for developed countries and some economies in transition but part of the adaptive capacity of less developed countries. While not certain, it is hoped that both clean water and sanitation will become part of the adaptation baseline for all countries. Decisions about public health measures unrelated

to climate change, such as sanitation and water treatment, may have a profound influence on health consequences associated with climate change. In fact, adaptation strategies frequently are described as risk management and public health programmes can be characterized as reducing climate change health risks. Improved weather warning and preparedness systems, buildings and infrastructure, all can be considered measures to reduce human health risks in the event of a changed frequency of weather disasters. However, there is concern that the adaptive capacity to address changes in the magnitude or frequency of extreme climatic conditions may not be very high even though the adaptive capacity to gradual changes in climate may be relatively high. Highly-managed systems, such as agriculture and water resources in developed countries are thought to be more adaptable (assuming resources to adapt are available) than less-managed or natural ecosystems. Similarly, systems that have coped successfully with historical and/or existing stresses are expected to adapt well to stresses associated with future climate change.

Poor communities in poor countries are most vulnerable to climate change and are already feeling its impacts, but have contributed least to the problem. Helping them to adapt to climate change is vital, but identifying steps to take and ensuring that this information reaches communities at risk is a major challenge. Community-based adaptation (CBA) and ecosystem-based adaptations are tools for achieving this.

13.8.1 Community Based Adaptation

Climate change has left communities and countries vulnerable to various kinds of hazards on an unprecedented scale. There is an urgent need to evolve community-based approaches, mechanisms and strategies that can safeguard the interests of communities against climate change. CBA is a bottom-up approach that places the community at the centre of determining how to respond to the impacts of climate change. CBA emphasizes community participation that builds on the priorities, knowledge and capacities of local people. These include aspects relating to the development and transfer of technology to improve adaptive capability and the ascertainment of community vulnerability through assessments of risks that communities face, amongst many others. It has been reported that community-based climate change adaptation (CBA) can be as simple as switching from one crop variety to another, or diversifying a farmer's livelihood. Further, CBA can be as complex as diversifying livelihood patterns against climate risks on a regional scale, or the incorporation of institutional reforms to create incentives for better localized natural resource management. The aforementioned should give the impression that CBA actions are not isolated to the local level/ the community (Reid et al. 2009). The framework for community-based adaptation encompasses "Climate resilient livelihoods", "Climate smart disaster risk reduction", "Enhancing adaptive capacity" and "Addressing the causes of poverty and vulnerability".

13.8.2 ECOSYSTEM-BASED ADAPTATION (EBA)

Ecosystem-based Adaptation (EbA) is the use of biodiversity and ecosystem services as part of an overall adaptation strategy in order to help populations to adapt to climate change. It aims at maintaining and improving resilience, and at reducing the vulnerability of ecosystems and individuals in the event of harmful climate change effects. EbA is an approach for addressing climate change impacts, focusing on the benefits humans derive from biodiversity and ecosystem services, and how these benefits can be utilized in the face of climate change. EbA is an approach to sustainable development that contributes to three outcomes: socio-economic benefits, climate change adaptation and ecological benefits.

EbA offers a response to climate change that has multiple co-benefits for people and biodiversity, contributing to sustainable development. These co-benefits of EbA can contribute towards a broader set of socio-economic and development goals, including job creation, poverty reduction and rural/peri-urban development. In effect, EbA interventions are “participatory, inclusive, and transparent”, and are construed to “support resilient and functional ecosystems” immensely. Further, it is considered as knowledge and evidence-based approach.

The risks from climate change are diverse, and the challenges and opportunities for adaptation vary by sector and policy area. Climate change adaptation are in dire need in the areas of infrastructure, gender, human health, agricultural system and livelihood.

Check Your Progress 2

- Note:
- i) Use the space given below for your answers.
 - ii) Check your answers with those given at the end of the unit.

1) Explain the community-based adaptation.

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2) Explain the ecosystem-based adaptation.

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13.9 LET US SUM UP

It is beneficial for countries to integrate long-term adaptation planning into development planning. Such integration offers development benefits in the short-term while reducing vulnerability in the longer term. To contribute to sustainable development and to ensure an adequate adaptation response, it is important to integrate adaptation with the Sustainable Development Goals (SDGs), as well as with long-term national development plans. There are various approaches to adaptation planning and actions, ranging from ecosystem-based adaptation (EBA), community-based adaptation (CBA) approaches, to risk-based approaches that countries can use individually, in combination, or utilize elements of several approaches for a particular situation. There are important connections between short-, medium- and long-term adaptation planning and implementation. In short, adaptation can become more about transformational change when considering longer-term climate scenarios and building enhanced resilience. Mainstreaming adaptation into long term development planning and cycles and connecting short, medium and long-term adaptation planning will ensure effective results. In this unit, we have discussed the characteristics and determinants of adaptive capacity, and the adaptive strategies against climate change.

13.10 KEY WORDS

Adaptive Capacity: The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

Climate Change Adaptation (CCA): Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

Community-based Adaptation (CBA): Climate change adaptation activities developed in partnership with at-risk communities, in order to promote local awareness of, and appropriate and sustainable solutions to current and future climatic conditions.

Disaster Risk Reduction (DRR): The concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land, water and the environment, and improved preparedness for adverse events

Ecosystem: A system of living organisms interacting with each other and their physical environment.

13.11 SUGGESTED FURTHER READING/

REFERENCES

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Web Links

<https://www.climatehotmap.org/global-warming-glossary/a.html>

<https://www.shareweb.ch/site/DRR/Documents/Related%20Sectors/CBD-EcoCCA-DRR-volontGuidelines-2018.pdf>

<https://docplayer.net/amp/57708118-Master-s-thesis-natural-resources-management-and-development.html>

<https://www4.unfccc.int/sites/NAPC/Country%20Documents/General/apf%20annexes%20a%20and%20b.pdf>

<http://www.ipcc.ch/report/ar5/wg1/>

<http://www.ipcc.ch/report/ar5/wg2/>

<http://www.ipcc.ch/report/ar5/wg3/>

<http://www.ipcc.ch/report/ar5/syr/>

<https://www.ipcc.ch/sr15/>

<https://www.globalchange.gov/climate-change/glossary>

CARE Community Based Adaptation Toolkit,
http://www.careclimatechange.org/files/toolkit/CARE_CBA_Framework.pdf

CARE Community Based Adaptation Toolkit,
http://www.careclimatechange.org/files/toolkit/CARE_CBA_Toolkit.pdf

13.12 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

- 1) Adaptive capacity is “the property of a system to adjust its characteristics or behaviour, in order to expand its coping range under existing climate variability or future climate conditions”. The adaptive capacity is the ability to design and implement effective adaptation strategies, or to react to evolving hazards and stresses so as to reduce the likelihood of the occurrence and/or the magnitude of harmful outcomes resulting from climate-related hazards.
- 2) The adaptive capacity is influenced by factors namely local, socio-economic and political factors. Principal determinants of adaptive capacity include economic wealth, technology, information and skills, infrastructure, institutions and equity. Others include social capital and good governance as additional key components. The determinants for adaptive capacity are also depicted through the availability of resources and their distribution across the population.
- 3) The Local Adaptive Capacity Framework by the Africa Climate Change Resilience Alliance (ACCRA) figure out the main determinants or indicators of adaptive capacity as the asset base of a community, institutions and entitlements, knowledge and information, innovation and governance.

Check Your Progress 2

- 1) “Community Based Adaptation” (CBA) is a bottom-up approach that places the community at the centre of determining how to respond to the impacts of climate change. CBA emphasizes community participation that builds on the priorities, knowledge and capacities of local people. These include aspects relating to the development and transfer of technology to improve adaptive capability and the ascertainment of community vulnerability through assessments of risks that communities face, amongst many others. The framework for community-based adaptation encompasses “Climate resilient livelihoods”, “Climate smart disaster risk reduction”, “Enhancing adaptive capacity” and “Addressing the causes of poverty and vulnerability”.
- 2) Ecosystem-based Adaptation (EbA) is the use of biodiversity and ecosystem services as part of an overall adaptation strategy in order to help populations to adapt to climate change. It aims at maintaining and improving resilience, and at reducing the vulnerability of ecosystems and individuals in the event of harmful climate change effects. EbA is an approach to sustainable development that contributes to three outcomes: socio-economic benefits, climate change adaptation and ecological benefits. In fact, EbA interventions are “participatory, inclusive, and transparent”, and are construed to “support resilient and functional ecosystems” immensely. Further, it is considered as knowledge and evidence-based approach.

UNIT 14 MITIGATION STRATEGIES

Structure

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 - 14.7.1 Need for Energy Management
 - 14.7.2 Energy Efficiency
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14.1 INTRODUCTION

The United Nations General Assembly adopted an important resolution (Res. 70) in September 2015 to set out 17 global Sustainable Development Goals (SDGs) and 169 targets to underpin transformation agenda popularly known as Post 2015 development agenda. Goal number 13 of this agenda calls upon to “take urgent action to combat climate change and its impacts”. Another major development around the same time was the adoption of the Paris Agreement on Climate Change, in December 2015. Both of these developments strongly advocate for a global economy based on low-emissions pathways.

The third assessment report of IPCC conclusively established the fact that human activities were the dominant reason for global warming observed during past 50 years. Report further says that human activities will continue to change atmospheric composition during 21st century. Fossil fuel burning will be the major contributor for such adverse consequences of human activities. In all likely possibilities, use of coal will increase primarily because it is cheap and available in abundance in United States, China and India. Moreover, it can provide usable energy at a relatively more affordable cost between \$1 and \$2 per MMBtu as compared to \$6 to \$12 per MMBtu for oil and natural gas (MIT, 2007). We have well documented studies to convincingly believe that there is more carbon dioxide in our atmosphere than at any time in the past 400000 years. The levels of CO₂ have exceeded dangerous proportion of about 400 parts per million. The rate of growth of CO₂ emission has unprecedented implications for rise in global mean temperature. Even if the carbon reduction targets set out in the 2016 Paris Agreement can be met, global temperatures could rise above 1.5°C by 2030 (Neil, 2019). In this unit, we would be discussing the climate change mitigation strategies. Further, we will be discussing the alternate energy options, carbon capture and sequestration and sustainable buildings.

14.2 OBJECTIVES

After studying this unit, you should be able to:

- define the climate change mitigation;
- discuss the mitigation strategies;
- explain carbon capture and sequestration;
- discuss the alternate energy options; and
- explain sustainable buildings.

14.3 CLIMATE CHANGE MITIGATION

The efforts made to prevent or reduce the release of greenhouse gas (GHG) emissions into the atmosphere or to enhance the absorption of GHGs already emitted, are referred as climate change mitigation. The primary aim of mitigation efforts is to reduce the magnitude of future warming. The measures used for climate change mitigation are mainly deployment of renewable energies and new technologies, enhancing energy efficiency, and improved sustainable agricultural and consumer practices (IPCC 2014; IPCC 2018). Intergovernmental Panel on Climate Change (IPCC 2014), defines mitigation as follows:

“The effort to control the human sources of climate change and their cumulative impacts, notably the emission of GHGs and other pollutants, such as black carbon particles, that also affect the planet’s energy balance. Mitigation also includes efforts to enhance the processes that remove GHGs

from the atmosphere, known as sinks” (IPCC, 2014).

Climate intervention measures consist of two major categories which are solar radiation management (SRM) and deployment of carbon dioxide removal (CDR) techniques (Royal Society 2009; IPCC 2018). The SRM measures primarily focus on the efforts to temporarily reduce or offset warming through changing the albedo. Such measures try to modify the earth’s ability to reflect solar radiation which brings down the peak temperature from climate change. Another set of strategies aim at reducing the concentration of carbon dioxide or GHGs already in the atmosphere. CDR techniques are different from climate mitigation strategies as they do not focus on reducing the amount of carbon dioxide or GHG emissions entering the atmosphere (mitigation).

14.4 NEED TO STABILIZE GHG CONCENTRATIONS

CO₂ is the most important GHG from the point of view of global warming. Its major sources are burning of fossil fuels (for example coal, natural gas, and oil), solid waste, trees, and wood products and also certain chemical reactions (e.g., manufacture of cement or glass). Plants are the natural sink for the CO₂. The carbon dioxide injected in the atmosphere automatically gets recycled through carbon cycle. However, it has very high residence time in the atmosphere almost of the order of centuries. It means that its presence in the atmosphere continues to affect the wellbeing of people for decades and centuries. The continuous injection of CO₂ in the atmosphere obviously leads to more and more heat getting trapped in the atmosphere thereby leading to increased global average surface temperature. The increasing concentrations of several other GHGs (CH₄, N₂O, HFCs, PFCs, SF₆) are exacerbating the problem.

Climate system has a delayed response to the stock of GHG and equilibrium temperature grows linearly with cumulative emissions of CO₂ (Bosetti et al. 2014). The CO₂ concentration in the atmosphere, way back in 1972 was building up at the rate of around one part per million (ppm) per year (Sachs 2015) whereas now it is increasing steadily at about 2 ppm per year. According to the IPCC (2014),

“Mitigation scenarios in which it is likely that the temperature change caused by anthropogenic GHG emissions can be kept to less than 2 Degree Celsius relative to preindustrial levels are characterized by atmospheric concentrations in 2100 of about 450 ppm CO₂eq (equivalent)” (IPCC, 2014).

Therefore, CO₂ concentrations can be stabilized only if global emissions peak further decline to zero in the long term. Moreover, if we want to stabilize the CO₂ concentrations at a lower value then the peak should be sooner and lower. Further the stabilization of GHG concentrations calls for fundamental changes in the global energy system relative to a baseline scenario. For

example, in order to bring CO₂ concentrations of 450 ppm in 2100, CO₂ emissions from the energy supply sector should be brought down to 90% below 2010 levels between 2040 and 2070, and in many scenarios fall below zero thereafter. Such decline is possible keeping in view of consistent energy efficiency improvements and increasing share of low and zero carbon energy technologies and of technologies aimed at negative emissions. It is estimated that to preserve a 50% chance of limiting global warming to 2 degrees Celsius, the world has a carbon budget of 3000 gigatonnes (Gt) (IPCC 2014). However, an estimated 1,970 Gt had already been emitted before 2014 leaving the energy sector for rest of the twenty-first century a carbon budget of just 980 Gt (IEA 2015).

Check Your Progress 1

Note: i) Use the space given below for your answers.

ii) Check your answers with those given at the end of the unit.

- 1) What are the SDG targets that have explicit linkages with climate change mitigation?

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14.5 MITIGATION STRATEGIES

One of the key responses to global warming has been to decrease the amount of GHG emissions released into the atmosphere by enhancing sinks. One of the major carbon sinks which you might be well familiar is the land cover of forests. Some mitigation strategies can be as follows:

- To develop and implement programs aimed at mitigating climate change.
- To initiate mitigation actions involving policies,
- To incentivize programs for clean activities across all sectors and involving all types of actors,
- To take initiatives and investment programs covering all sectors.
- To initiate mitigation actions such as increased use of renewable energy, application of new technologies in areas like lighting and transportation, and behavioral adjustments like lifestyle change.
- To conserve natural sinks through expanding forests
- To protect oceans, so that they remove more carbon dioxide from the atmosphere (UNFCCC)

There have been strong realizations that existing mitigation efforts fall short of the Paris Agreement's temperature targets (UNFCCC 2016; IPCC 2018). As per the synthesis report on the aggregate effect of 161 intended nationally determined contributions (INDCs) the impact of such NDCs is likely to lead to a 3 degree rise in temperature. It is much higher than 2- degree target and 1.5-degree aspirational target of Paris Climate Change Agreement (UNFCCC, 2016).

It has triggered an idea of "...deliberate large-scale intervention in the Earth's climate system, in order to moderate global warming" (Royal Society 2009; IPCC 2018). There are two main overarching categories of climate intervention actions, first is Greenhouse Gas (GHG) removal and another is Solar Radiation Management (SRM) (Royal Society 2009). Among both of these strategies, Carbon dioxide removal (CDR) which primarily aims at removing atmospheric carbon is the most developed form of GHG removal. It includes ocean fertilization, ocean liming and carbon capture and storage. On the other hand, SRM techniques aims at intercepting solar radiation before it reaches Earth's surface for example through injecting particles into the stratosphere to deflect sunlight or spraying aerosols into low-lying marine clouds to make them more reflective (Royal Society 2009). However, climate intervention measures are complex and have raised several apprehensions that could have negative ecological and socio-economic effects (Encyclopedia, 2020). Moreover, the science of such climate intervention methods remains uncertain.

14.6 CARBON CAPTURE AND SEQUESTRATION (CCS)

CCS is a set of technologies that can greatly reduce carbon emissions from new and existing coal- and gas-fired power plants and large industrial sources. It is a three-step process which includes capture of carbon dioxide from power plants or industrial processes, its transport (usually in pipelines) to a site where it is injected underground for permanent storage (also known as "sequestration") into rock formations beneath the surface. The reductions of net CO₂ emissions provide a protection strategy for power plants that would otherwise be decommissioned or become stranded. Though a variety of pilot projects have critically advanced our understanding of the carbon capture technology, it is yet to be applied at large scale. There are still diverse opinions about its usefulness. One of the major reasons is that it is an expensive technology and therefore requires substantial cost reduction or economic incentives to become a dependable mechanism for large-scale future deployment of CCS. In addition to economic incentives, there is a strong need for well-framed regulation and coherent emission reduction policy scenarios. Moreover, there are apprehensions about long term safety and environmental concerns. Also, there is limited evidence of the potential consequences of a pressure buildup within a geologic formation caused by CO₂ storage (such as induced seismicity) and on the potential human health

impacts from CO₂ that migrates out of the primary injection zone (IPCC 2014).

The ultimate objective of UNFCCC is to stabilize the GHG concentrations to prevent such anthropogenic changes in climate system from reaching dangerous levels. However, the specific level limits of such GHG have not been conclusively agreed to. The technological options available to bring down the carbon emissions are as follows: Reducing energy consumption through less energy-intensive economic activities and energy efficient processes; encouraging less carbon intensive fuels, increasing the use of renewable energy sources or nuclear energy, sequestering CO₂ by enhancing biological absorption capacity in forests and soils and lastly capturing and storing CO₂ chemically or physically (IPCC, 2005).

Though the first four options given above are already well documented in several other earlier IPCC reports, the fifth option i.e., carbon capture and storage were the subject matter of third IPCC report (IPCC, 2005). It propagated the idea that CO₂ produced by fossil fuel burning should be captured and stored away from the atmosphere for a very long period of time. The third assessment report examined the available knowledge about different dimensions of this option to explore whether it is viable option for mitigating climate change.

CASE STUDY-1: CARBON ENGINEERING

Carbon capture is increasingly been recognized as an important contributor to carbon mitigation efforts around the world. There are around 21 CCS projects in operation or under construction around the world. Various financial agencies and companies have started investing in this technology. One such venture is Carbon Engineering which has been capturing atmospheric carbon di-oxide since 2015, by constructing an end-to-end Direct Air Capture pilot plant in Squamish, B.C., Canada. This company was started in 2009 by a Harvard Professor David Keith, in Calgary, Alberta. A large team of academic scientists, business leaders, and strategic investors was involved and the main aim was to develop and commercialize technology that captures climate-relevant quantities of CO₂ from the air. In collaboration with Oxy Low Carbon Ventures, LLC (OLCV), a subsidiary of Occidental, this company is now working on the world's largest direct air capture plant that is one million tons of CO₂ directly from the atmosphere each year. The captured carbon di-oxide will be permanently stored underground. The carbon di-oxide will be utilized in OLCV's enhanced oil recovery operations. In 2021, CE is expected to start the construction of its first large-scale commercial plants. This project will be deployed in partnership with Oxy Low Carbon Ventures and will be built in the Permian Basin, U.S. Carbon Engineering is also progressing the opportunities to further Direct air capture plants in different markets around the world. In 2017, CE incorporated fuel synthesis capability into Direct air capture pilot

plant of Squamish, making the world's first Air to Fuel pilot based on industrially scalable technologies.

Source: <https://carbonengineering.com/our-story/>

CASE STUDY-2: THE CARBFIX METHOD

Though carbon capture can be a vital option for any carbon reduction plan, there are several unanswered questions in this regard. For example, an important issue is what to do with the captured stuff. A possible solution is to bury the captured carbon dioxide, for example Reykjavik Energy's CarbFix Project in Iceland, since 2012, has been injecting carbon dioxide in water deep underground. The Carbfix method is considered to be an economical and environmentally friendly way to permanently immobilize carbon. It involves the process of dissolving CO₂ in water under pressure and then pumping it to a depth of 500-800 meters into basalt strata where it gets permanently mineralized. Reykjavik Energy (RE), since 2007 developed this method in collaboration with the University of Iceland and several other research institutions. Efforts have also been made to recycle captured carbon dioxide back into usable fuels such as ethanol under laboratory conditions, though it is yet to be commercialized.

14.7 ENERGY MANAGEMENT

Industrial development and population growth led to increased demand for energy during 1850-1970 primarily due to enormous increase in world population (~3.2 times), per capita use of industrial energy (~twenty-fold) and total world use of industrial and traditional energy (~ twelve-fold). This demand was predominantly met through biomass-based energy systems initially and gradually developed a heavy reliance on coal and gas. However, consumption of such non-renewable sources started generating high concentration of harmful gases in the atmosphere leading to serious repercussions like ozone depletion, higher levels of Greenhouse Gases (GHGs) and consequently the increasing global warming. The maximum contribution to GHG emissions comes from energy sector which roughly constitutes two third of all the anthropogenic GHG. The increasing dependence on fossil fuels is primarily driven by the electrification of the energy system (IPCC 2014). Therefore, electricity generation is the major sector which is responsible for emission of fossil fuel CO₂.

For a sustained economic growth, we need efficient, reliable and competitively priced energy supplies. This is the reason why efficient use and long-term sustainability of energy resources is at the core of energy management particularly in developing countries where the access to clean and reliable sources of energy is still a major challenge. There is a need to

carefully plan the mitigation strategies both in the energy supply sector and energy demand sector. Energy supply sector includes all those processes that deliver final energy to the end-use sectors. However, the technological advancements have given rise to several mitigation options. Several possibilities exist in energy supply and demands sectors to mitigate the climate change, for example use of renewable and nuclear energy sources increased efficiency, fuel switching (e.g., from coal to gas), Carbon Capture and Sequestration (CCS), and energy efficiency at household or business level, or in transport.

14.7.1 Need for Energy Management

The fossil fuels have a limited stock in our environment. However, they are being consumed at very high rate. About 85 % of the primary energy at present comes from fossil fuels. Once they are completely consumed, we will not have such fuels available any more for future generations. Further we know that a significant amount of energy gets wasted in our country. There is a dire need to judiciously utilize energy resources and prevent energy death for our coming generation. For this purpose, we should have a proper understanding of how long such resources might be available and how they can be made to last longer. In this context the energy conservation and its management become an important issue of concern for all of us. How we produce and consume energy resources is a major issue of concern. In this regard the overall efficiency of energy production needs to take very seriously. Unfortunately, the overall energy efficiency is extremely low.

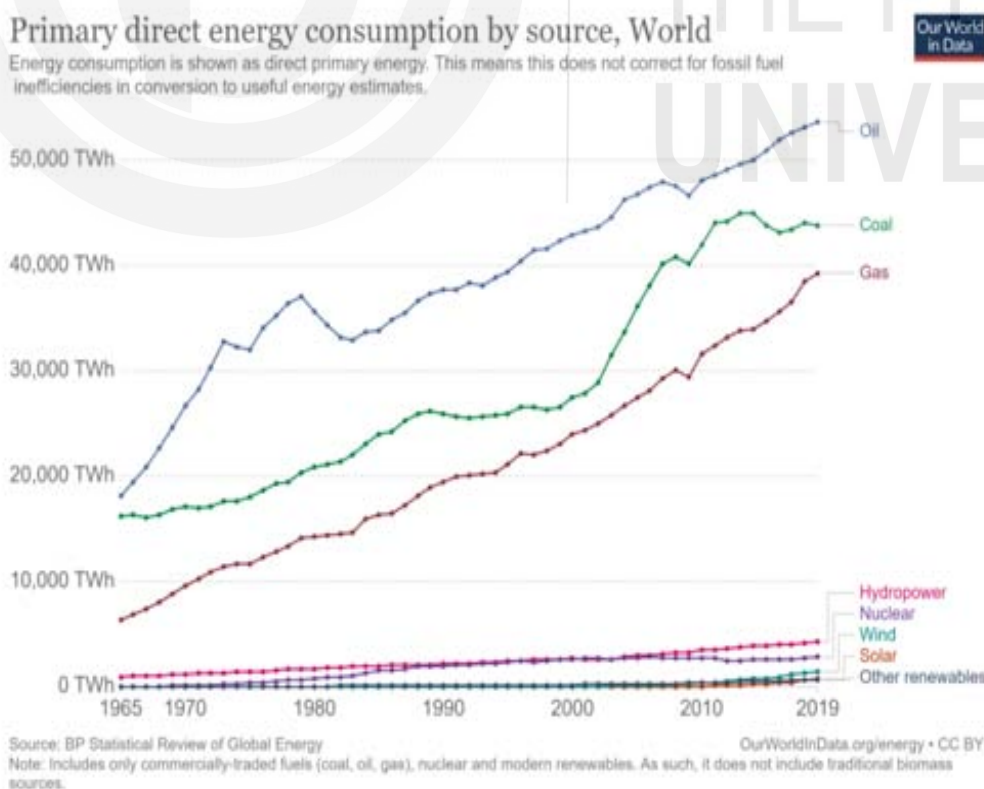


Fig. 14.1: Primary direct energy consumption by source, World

14.7.2 Energy Efficiency

Energy efficiency signifies using less energy for carrying out the same tasks. The energy efficiency carries significance because reduced energy consumption can bring down greenhouse gas emission. The concept of energy efficiency applies in several different areas for example designing of buildings, using smart meters or designing household appliances. As you know that compact fluorescent bulb uses less electricity than conventional electric bulb. Similarly internal temperature, illumination, landscaping etc. can be regulated through design considerations of the buildings to minimize energy consumption. Smart meters help to keep track of the usage of energy in the buildings to develop systems for making buildings more energy efficient. Such energy efficient design considerations in appliances, buildings etc. will help to consume lesser and lesser electricity and thus effectively contribute for climate change mitigation efforts. Here you need to understand the difference between energy conservation and energy efficiency. Though both of them have similar goal to reduce energy consumption, they are conceptually not the same. When we are talking about energy conservation, we are concerned about cutting back activities which consume energies, for example by switching off lights, driving less frequently, using appliances less etc. However, energy efficiency deals with our concern to harness technology to reduce energy wastage. Though development of such energy efficient devices or systems often cost intensive but the invested capital will pay back in long term through reduced energy consumption. Thus, improvement in energy efficiency is important in several ways. It is good for country's economy which would otherwise burden with energy import requirements, for people's domestic budget and most importantly for climate change mitigation besides the several indirect benefits like reduction in air and water pollution caused by unclean energy sources. Though renewable energy options can also help to address such issues, improvement in energy efficiency is the cheapest and most immediate way to reduce the carbon emissions.

Check Your Progress 2

Note: i) Use the space given below for your answers.

ii) Check your answers with those given at the end of the unit.

1) Differentiate between primary and secondary energy resources.

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2) Differentiate between renewable and non-renewable energy resources.

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3) Differentiate between commercial and non-commercial energy resources.

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14.8 ALTERNATE ENERGY OPTIONS

Due to the environmental problems created by the extensive use of fossil fuels, alternative sources of energy are being sought across the world. The ideal energy sources are the ones which last forever and do not pollute the environment. The energy sources derived from sun, wind, water, agricultural residues, fuel wood, and animal dung are inexhaustible and therefore popularly known as renewable sources. They are non-polluting and are available locally which is why they are viable sources of clean and limitless energy.

Among all the climate mitigation options, Renewable Energy (RE) is one of the most important options. The technologies powered by RE sources are much clean than those powered by fossil fuel-based resources. It is primarily because of the fact that lifecycle GHG emissions normalized per unit of electrical output (g CO₂eq/kWh) in such technologies is less (IPCC 2012). Despite their low life cycle GHG emissions, the long-term contribution for climate change mitigation in respect of few RE sources is limited. For example, for bioenergy, the available technical potential is limited, if we seek deep reductions in GHG emissions. However solar and wind energy, despite their seemingly higher technical potential for solar and wind energy, face obvious constraints due to changing weather patterns. The deployment of RE technologies is a complex matter which inter alia needs to take in to account environmental concerns, public acceptance, and investment in infrastructure.

14.8.1 Bioenergy

The energy produced from natural biological sources (e.g., plants, animals and their byproducts) is called bio-energy. It can be used in various forms like liquid form (e.g., biofuel), gaseous form (e.g., biogas) or solid form (e.g.,

burning wood for energy). Forests, agricultural fields and wastes are the prominent sources for the production of bioenergy. The raw materials derived from these sources can be converted into bioenergy through chemical, thermal and biochemical methods. Under chemical processing biofuel is developed through chemical processes. In thermal conversion heat is used through combustion or gasification. In biochemical conversion processes, bacteria or other organisms are utilized to compost or ferment the source to convert it into energy.

The energy retrieved from sources like plants is basically the solar energy stored in them through photosynthesis. Therefore, this source of energy can be replenished. The bioenergy can therefore be treated as inexhaustible source of energy. As the biomass is obtained from the farms, forests and other ecosystems, it has several positive and negative environmental and social impacts. Though it uses almost similar amount of carbon dioxide, as fossil fuels, we can minimize the adverse impact of such emissions by way of replacement of used resources by fast growing trees and plants (bioenergy feedstocks). However, through advanced technologies, bioenergy can reduce GHG emissions. Bioenergy can be generated locally at several levels for example individuals using compost heaps out of kitchen scraps or large-scale corporations using huge farms. Bioenergy has promising role to minimize GHGs and fulfill the energy needs of people beyond the reach of grid-based energy infrastructure. However, this form of energy generation is not yet fully ready to replace fossil fuels. It is too costly and utilize so many resources like large plots of land, water requirements etc., which make it unreasonable sometimes.

14.8.2 Solar Energy

As far as electricity generation is concerned, the solar energy technologies can be divided into two considerably different categories i.e., solar photovoltaic (PV) which transform sunlight into electricity directly and concentrated solar power (CSP) which does it through the production of steam and the use of turbines and generators. These two technologies have another difference in that with CSP the storage is possible whereas in case of PV, the storage is difficult and most expensive. The energy is abundantly available from the sun though it undergoes changes during night time or cloudy or rainy days. This is the reason why PV solar power systems need a backup system to maintain continuity in the energy supply. However, CSP technology requires much larger area and therefore suits the requirements in certain geographical areas and long days of direct sunlight. On the other hand, PV systems are scalable and therefore adaptable to different conditions. Though existing supply of solar energy is a small fraction of global energy supply, it has highest potential among all energy sources. As the technological advancements and cost reductions are continuously going on, we can hope to see a dramatic deployment of solar based technologies in near future.

14.8.3 Wind Energy

Wind energy is basically a kind of solar energy. It is created due to uneven warming of earth's atmosphere, differences in landscape and revolution of earth. Wind induced mechanical power is transmitted to generators which produce electricity. Wind energy is second fastest growing source of electricity in the world after solar energy, both of which are hygienic and cheapest option in many countries. China, USA and Germany are the prominent user countries of wind energy. However potential of wind energy generation depends upon region and season. Wind energy has a significant potential to address near term (2020) and long term (2030 to 2050) GHG emission reduction. The global wind energy capacity in 2017 had reached about 23 % of the global RE capacity largely from onshore wind applications (IRENA, 2018). Though there are range of wind energy technologies presently available in the market, there are environmental and social acceptability issues which restrict its possible use. Moreover, wind power cannot work when wind is not blowing and therefore cannot completely replace conventional sources. However, we can still rely on wind energies because they can put the polluting and inflexible power plants offline while they are in use and thus bring down GHG emissions.

14.8.4 Geothermal Energy

The heat (thermal) energy extracted from the interior of earth (geo) is known as geothermal energy. It resides within earth's interior in rocks, steam, or liquid water (filled in the fractures and pores within the rock). Geothermal energy is considered to be useful to generate utility scale electricity. In order to carry out this process deep wells are drilled to tap vapor and hot water from underground reservoirs. The steam is used to drive turbines to generate electricity.

Geothermal energy can also be used to heat and cool buildings. In many areas, during colder months the underground temperature remains constant (about 50–60°F) which is much warmer than the outside air. For the purpose of heating and cooling buildings, earth's surface is used as temperature exchange medium. It is achieved through geothermal (or ground-source) heat pumps. The heat can be absorbed through, water or another fluid running through pipes buried 10–300 feet underground or underwater. Subsequently deposited heat is passed through air ducts in the building. The cooling process is just the opposite. As opposed to fossil fuels geothermal energy does not discharge the GHGs. Moreover, the marginal cost of the fuel is low as the only cost involved in this process is the initial cost of set up. Keeping in view of its technical potential and likely deployment, it can meet about 3% of global demand for electricity by 2050. As on 2017, the capacity of geothermal energy is only 12,894 MW (IRENA 2018).

14.8.5 Hydroelectric Energy

The hydroelectric power is a mature technology though already over exploited in many regions. Hydropower is renewable because water is naturally replenished through the water cycle. Moreover, it is clean energy alternative because it does not add to the GHG emissions. Hydropower has the largest share of the global RE capacity though expected to decrease by 2050 (IRENA 2018). However, it continues to remain an attractive source keeping in view of global carbon mitigation scenarios. Hydroelectric projects are vulnerable to climate change effects primarily because of shifts in rainfall patterns.

14.8.6 Ocean Energy

The source of ocean energy is the kinetic, thermal, and chemical energy of seawater. This energy can be converted in to electricity and thermal energy. The oceans cover about 70% of earth's surface which make it the biggest collector of solar energy. The oceanic surfaces are warmed a lot more than deep oceanic water which creates thermal energy. Different kinds of technologies are used to convert different possible sources of ocean energy (e.g., waves, ocean currents, and tides). However, ocean energy's contribution for climate change mitigation is very less which is evident from the fact that -as on 2017- global capacity for ocean energy was just 529 MW (IRENA 2018). A better utilization of ocean resources will require improvement in various technologies and making it commercially viable at attractive rates.

14.8.7 Nuclear Energy

Nuclear energy is a matured technology which represented 11 % of the world's energy generation in 2012 with a total generation of 2346 TWh (IAEA 2013). It has low carbon emissions which is below 100 g CO₂eq per kWh on a lifecycle basis. Though globally it is utilized in 30 countries for electricity generation, a variety of safety concerns and nuclear waste management related issues have restricted its social acceptability. The nuclear accidents in 1986 at Chernobyl Ukraine and in 2011 at Fukushima Japan have created further apprehensions for safe utilization of nuclear energy. Since 1993 nuclear energy share of global electricity generation has been declining (IPCC 2014).

14.9 SUSTAINABLE BUILDINGS

The modern buildings require energies for a variety of purposes for example lighting, heating and cooling which is primarily met by commercial sources of energy. A significant part of the commercial energy is consumed by the buildings if it is not scientifically designed from the point of view of energy consumption. Such energy consumption takes place at several steps for example materials used in construction, developing comfortable living

conditions inside the constructed building etc. As a result of fast expansion in construction sector, the requirement for energy consumption in this sector is increasing at a rapid pace. Keeping in view of the huge gaps in demand and supply of the commercial energy, there is a need to suitably design buildings. The architects, engineers, interior designers and other building design professionals have to play a significant role in this regard. The consumption of commercial energy can be significantly reduced by employing solar features in the building which are commonly called solar passive buildings or energy-conscious buildings. Energy savings result primarily due to reduction in energy used for thermal comfort conditioning and lighting when the building begins operation. On the other hand, solar active buildings use mechanical devices like pumps and fans etc., to distribute sun's captured energy amongst the areas of living spaces. The reduced consumption of commercial energy resources leads to reduction of greenhouse gases.

14.9.1 Designing Energy Efficient Buildings

Designing of energy efficient buildings requires several factors to be taken in to consideration. Some of these factors are size, shape, orientation, special arrangements, materials and many other factors that affect energy use with the building. The design of the building should be climate responsive to make them energy efficient and to reduce their energy consumption. Efforts should be made to integrate the buildings with renewable energy devices to generate energy at the site of building which will further reduce consumption of conventional energy sources. The building interacts with its environment through its walls, windows, roof, door and floor etc., which forms the building envelope. The energy efficiency of the building will obviously depend upon how well building envelop has been designed keeping in view of elements of climatic conditions such as solar radiation, ambient temperature, wind direction, level of humidity. For instance, we need to prevent heat gain and promote heat losses while constructing buildings in climatic zones represented as hot and dry, warm and humid, and moderate. However, in cold climatic zones, we need to promote heat gain and reduce the heat losses. Moreover, the site conditions (e.g., availability of trees, water bodies etc.), orientation of the building (which decides solar energy it receives during winters and summers) and proper building configuration also play a significant role in building's performance. The Government of India is promoting the solar buildings. The concept of such building is very close to architecture of heritage buildings viz. Red Fort of Delhi, forts and havelis in Jaipur, Jaisalmer and Jodhpur. Such architecture works in harmony of nature. The design of solar buildings helps to save money in long term through energy reduction though it may cost a little higher initially.

Check Your Progress 3

Note: i) Use the space given below for your answers.

ii) Check your answers with those given at the end of the unit.

1) What are the advantages and disadvantages of Solar Passive Housing?

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14.10 LET US SUM UP

Keeping in view of the targets of Paris Agreement on climate change we can no longer emit any further carbon dioxide in the atmosphere. Therefore, reducing emissions of GHGs is one of the major challenges of our times. Though there are several sources of anthropogenic GHGs, the energy sector represents about two-thirds of such emissions. Within energy sector, electricity generation is the major contributor of CO₂. It is due to this reason that we expect this sector to play a major role in mitigation scenarios. It calls for, fostering renewable energies and new technologies, making older systems more energy efficient and changing management practices and consumer behavior.

We need to explore innovative ways to remove significant CO₂ from the atmosphere. In addition to biological options (e.g., afforestation and bioenergy with CO₂ capture) direct carbon capture and sequestration (DACC) has emerged as a promising possibility though it is yet to gain sufficient ground. Under the existing circumstances no credible emission scenario appears to emerge under which global mean temperatures can peak and then decline by 2100.

14.11 KEY WORDS

Mitigation: A human intervention to reduce the sources or enhance the sinks of greenhouse gases.

Solar Radiation Management (SRM): Solar Radiation Management refers to the intentional modification of the Earth's shortwave radiative budget with the aim to reduce climate change according to a given metric (e.g., surface temperature, precipitation, regional impacts, etc.).

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14.13 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

- 1) The interconnections between climate change mitigation and some of the sustainable development goals are evident. The following table describes some of those targets which are explicitly connected.

Sustainable Development Goal	Target which is explicitly interlinked to climate change mitigation
No Poverty	SDG1.5
No Hunger	SDG2.4
Clean water and sanitation	SDG6.4 SDG6.6
Affordable and clean energy	SDG7.1 SDG7.2 SDG7.3
Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	SDG9.4

Sustainable cities and communities	SDG11.B
Responsible production and consumption	SDG12.2 SDG12.4
Climate action	SDG13.2 SDG13.3 SDG13A

Check Your Progress 2

- 1) The primary sources of energy are found in nature and they are then converted in to secondary sources through industrial operations. For example, coal, oil and gas are primary sources whereas steam and electricity are secondary sources of energy.
- 2) The resources like coal, oil and gas have limited stock on the earth. They get continuously depleted as it is not possible to recoup their stock within a reasonable period of time. These kinds of resources are called fossil fuels because they are found underground where they are formed over millions of years. Hence such resources have limited supplies and are practically non-renewable. However hydro energy, wind energy, biomass energy, solar energy, tidal and geo-thermal energy are dependent on sun and will continue to last till sun exists. This is the reason why we call them renewable, nonconventional or alternative energy sources.
- 3) Commercial energy resources are available in the market for a specific price for example coal, oil, natural gas, electricity and refined petroleum products. However, non-commercial energy resources are not bought or sold at any specific prices in markets for example, cattle dung, agricultural wastes, solar energy, animal power for transport.

Check Your Progress 3

1) Advantages of Solar Passive Systems

Solar passive systems are highly energy efficient as a result of which the energy requirements for lighting, winter heating, and summer cooling are reduced substantially. Since such systems have very little dependence on conventional sources of energy, it helps to save on expenditures and consumption of fossil fuels (coal, oil and gas). Further such systems reduce the emission of greenhouse gases.

Disadvantages of Solar Passive Systems

The solar passive systems costs little more than conventional building design therefore initial cost is on higher side. Moreover, the design of such buildings has to be carefully planned and any mistake, for example in the choice of building materials or window glass, may give adverse results.

UNIT 15 EDUCATION AND CAPACITY BUILDING

Structure

- 15.1 Introduction
- 15.2 Objectives
- 15.3 Emerging International Concerns
- 15.4 Emerging Perceptions for Climate Education
- 15.5 Need for Curriculum Changes
- 15.6 Flexibility and Innovations: Hallmarks of Climate Change Education
- 15.7 Capacity Building: International Concerns
 - 15.7.1 Capacity Building in the context of UNFCCC
 - 15.7.2 International Cooperation
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15.1 INTRODUCTION

Climate change has thrown up several developmental challenges for mitigation and adaptation measures, both in developing and developed countries. There is a need to effectively deal with climate change induced loss and damage; to put in place credible monitoring mechanisms; to adopt new technologies and methods; and raise awareness on climate change etc. (ECBI, 2017). There is a widespread realization that response strategies for climate change will require a central role of education. Education helps people understand and address the impact of global warming, encourage change in their attitudes and behavior and help them adapt to climate change-related trends (UNESCO, n.d.). The education and capacity building has also attracted the attention of policy makers, environmental activists, multilateral organizations and stimulated diplomatic activities across the world. Ever since United Nations Framework Convention on Climate Change (UNFCCC) came in to existence in 1992, several international declarations have emphasized on the importance of education and capacity building to effectively deal with climate change.

However, climate change has differential impact on different countries. Developing countries have been disproportionately affected, primarily due to

poor human, technical, institutional and financial capacity to deal with such challenges. The impact has been manifested at various social, economic and environmental fronts which have thwarted the hard-earned developmental gains of these countries. A large segment of population which had come out of poverty trap in these countries has a risk of slipping back in to poverty due to climatic change. It impinges on already constrained financial resources of such countries to ensure food, water and energy security, and livelihoods and health. Various stakeholders therefore need additional capacity, not only to deal with the additional challenges of climate change, but also to enhance development efforts and safeguard development gains (ECBI, 2017). Despite the wide-ranging multilateral and bilateral efforts, the impact in developing world is limited. Many developing countries still face capacity challenges which jeopardize their ability to effectively or fully carry out the desired climate action. The major challenges reported by the studies are as follows: (Dagnet, Northrop and Tirpak, 2015):

- A lack of public awareness and support for climate action within countries;
- Fragmentation of information, experts and research institutions and lack of training in assessment approaches and methodologies;
- Lack of international support directed at building and retaining long-term organizational and institutional capacity; and
- A need to establish or strengthen permanent institutional arrangements and enabling environments fit for meeting national climate change goals.

A strong and effective global cooperation will be critical to bring about these capacities at various levels in these countries particularly the least developed countries. As a student of Environmental Sciences, you should have a clear understanding of the overall perspective within which such global response for education and capacity building is coming up. This unit will make you understand the vital role of education, its current status and the changes required in educational systems. You will also learn the conceptual difference between education and capacity building; the chronological sequence of concerns shown by some major international declarations; problems being faced by developing countries and the major initiatives for climate change capacity building across the world.

15.2 OBJECTIVES

After studying this unit, you should be able to:

- define capacity building;
- discuss climate change education; and
- discuss the International concerns for capacity building and climate change education.

15.3 EMERGING INTERNATIONAL CONCERNS

Several agencies across the world are working for climate education in their own ways and in accordance with their mandates. However, UNESCO has been playing a vital and pioneering role. UNESCO implements climate change education as part of its program on ‘Education for Sustainable Development’. As defined by UNESCO, ‘Education for Sustainable Development’ should entail knowledge, skill, attitudes and values that would enable an individual to work towards building a sustainable future. Climate Change Education for Sustainable Development (CCESD) “*has a central role to play in helping the general public and especially the next generations understand and relate to the issues, make lifestyle changes to reduce greenhouse gas emissions, and adapt to the changing local conditions*” (UNESCO 2010a).

The concerns for education or capacity building have been consistently shown in several international agreements starting from United Nations Framework Convention on Climate Change (UNFCCC) held in 1992. A chronological sequence of some prominent declarations is given in Table 15.1.

Table 15.1

Concerns shown for Capacity Building in international declarations in connection with Climate Change: A Chronological Sequence

Declaration/Agency	The Concern for Capacity Building
<p>1992 UN Framework Convention on Climate Change (UNFCCC)</p> <p>Reference: https://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/conveng.pdf</p>	<p>Article 6 of the Convention is dedicated to promoting education, public awareness, public access to climate change information, public participation in addressing climate change, and training of scientific, technical and managerial personnel.</p> <p>In addition to the formal processes under the UNFCCC, there are about 13 thematic and financial entities involved in capacity building</p>
<p>1997 Kyoto Protocol</p> <p>Reference: https://unfccc.int/resource/docs/convkp/kpeng.pdf</p>	<p>Article 10 of the Kyoto Protocol provides for strengthening of research capacity, education and training of personnel and institutional strengthening in developing countries.</p>

<p>2001 Marrakech Accords The Seventh Conference of Parties (COP7) to UNFCCC Reference:https://unfccc.int/process-and-meetings/conferences/past-conferences/marrakech-climate-change-conference-october-2001/cop-7</p>	<p>Marrakech Accords include two frameworks providing a set of guiding principles and approaches to capacity building – one in developing countries, and the other in countries with economies in transition (EITs).</p>
<p>2012-2017 Durban Forum on Capacity Building Reference:https://unfccc.int/topics/capacity-building/workstreams/durban-forum/background-on-the-durban-forum</p>	<p>To further enhance the monitoring and review of the effectiveness on capacity building efforts. The Forum is open to Parties, UN organizations, intergovernmental and non-governmental organizations, research, academia and the private sector. Six meetings have taken place between 2012-2017</p>
<p>2009 Climate Change Initiative of UNESCO (During the 15th COP of the UNFCCC) Reference: http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/SC/pdf/sc_climChange_initiative_EN.pdf</p>	<p>It includes climate change education as one of its four thematic areas to strengthen its Member States and calls for capacities to deliver Climate Change Education for Sustainable Development (CCESD) at the primary and second levels, to encourage and enhance innovative approaches to CCESD in schools and to raise climate change awareness through non-formal education</p>
<p>2015 Paris Agreement Reference: https://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf</p>	<ol style="list-style-type: none"> 1. It deals with capacity building under Article 11. The five paragraphs of this Article lay down the goals, guiding principles, and procedural obligations of all Parties to the agreement with regard to capacity building. 2. Paragraph 71, establishes the “Paris Committee on Capacity Building” (PCCB) to address capacity gaps and needs, both current and emerging, and enhance capacity

	<p>building efforts.</p> <p>3. Paragraph 73 of the adopting decision launches a work plan on capacity building for the period 2016-2020</p>
<p>2015</p> <p>Sustainable Development Goals (SDG)</p> <p>Objective 13 of Sustainable Development Goals</p> <p>Reference: https://www.undp.org/content/undp/en/home/sustainable-development-goals/goal-13-climate-action.html</p>	<p>1. SDG-13.3 points out the necessity to: “Improve education, awareness-raising and human and institutional capacity on climate changes mitigation, adaptation, impact reduction and early warning”</p> <p>2. SDG- 13.2 which stresses the necessity to “Integrate climate change measures into national policies, strategies and planning,”</p>

(Source: Compiled from ECBI, 2017)

UNFCCC called upon the countries to initiate educational interventions for climate change. Though most of these countries have committed to climate change education, concrete action needs to be taken for setting targets and advancing action on climate education. Most of such initiatives are taken as stray initiatives which lack an integrated perspective on for climate change capacity building. It has also been observed that the countries are also slow to address climate change education in preparing their Nationally Determined Contributions under Paris Agreement and therefore need technical support (UNESCO, 2019).

A study conducted by UNESCO has revealed that most of the initiatives in different countries under UNFCCC are related to public awareness and integration of climate knowledge in to classrooms (UNESCO, 2019). It is not sufficient because just the knowledge about climate change may not translate in to required behavioral and attitudinal changes. Furthermore, countries tend to report more on ‘Environmental Education’ than the ‘Education for Sustainable Development’.

15.4 EMERGING PERCEPTIONS FOR CLIMATE EDUCATION

The education for climate change is required by diverse stakeholders with varying levels of vulnerabilities, livelihoods commitments, prior learning levels and value systems. Educating such target groups cannot be carried out through structured academic programs of educational institutions. Climate change education is all about building capacities and generating knowledge for context-based solutions. It’s a challenge for educational institutions to

fulfill this mandate. Innovation and flexibility will be the hall marks of such climate education initiatives (Pandey and Kumar, 2018). Several out of box initiatives have been taken across the world which will be described later in this unit. However, in order to understand the intricacies of climate education you should understand the following few points which will make you understand why climate education cannot be addressed through Business-as-usual approach. Following few points of views make climate education a specialized area of study.

- **A shift in perceptions**

We are passing through an unprecedented shift in the way developed countries used to look at developing countries. The poor capacities of the developing countries to handle climate change are a major source of worry for developed countries also. Nowhere in human history, was it so deeply realized that prosperity of developed nations is not sustainable without the well-developed capacity building infrastructure in developing countries. This is an unprecedented trend in the field of climate education. Most of the challenges which human civilization faces today have to be addressed collectively. Further, there is an increasing realization to advance a climate justice perspective – in order that climate inequities and inequalities are acknowledged and can be advocated for. For example, least responsible for causing climate change and having the least financial, human, and other resources to address it are most vulnerable to its devastating impacts. Therefore, developed countries now feel accountable to build up capacities in developing countries.

- **Vulnerability of Target Groups**

The role of climate education is especially important in the countries where the communities are highly vulnerable. Climate change will make them more vulnerable thereby jeopardizing the hard-earned developmental gains of past several decades. The target groups for climate education are mostly dependent upon climate sensitive livelihoods, have subsistence levels of living and disconnected from urban centered educational infrastructure. Educational system has the responsibility to enhance coping capacities of such vulnerable communities and build up required capacities of policy makers, scientists, archeologists, urban planners, engineers etc.

However, this task is challenging especially in developing countries where the target groups to be addressed are vulnerable, poorly capacitated to adopt new practices, depend on highly climate sensitive livelihoods and largely live in remote and rural areas. The conventional ways of capacity building, fail to serve the educational requirements of such target groups. During the past few years Indian Universities have launched several initiatives for Curriculum Development, Program Delivery and Community Outreach Programs to address the issues of sustainability. Though perhaps, India has been the only country where the highest court has mandated environmental education at all

the formal levels of education including a compulsory undergraduate course there have been significant gaps. Such gaps between policy and practice have been primarily due to non-availability of interdisciplinary competence among teachers and staff and use of traditional methods (Banga, 2010). Open and Distance Learning systems are ideally positioned to address these issues primarily because of their flexible and innovative ways of functioning.

- **Environmental Implications of Universalization of Education**

There is an increasing realization across the world that we need to develop carbon neutral educational systems to play a meaningful role of education for climate change. Global commitments made under SDG-4 will require huge expansion of our educational systems. Though the world has already achieved targets very close to universalization of primary education, we find that a lot has to be done to achieve universality in lower and upper secondary education. The targets to be achieved for tertiary education are still more difficult. The existing rates for tertiary education are only 38% which shows the scale of expansion needed for such universalization of higher education.

Carbon foot prints of educational activities are increasingly becoming a cause of concern. The carbon foot print for expansion of such a scale will be huge. It will have implication for the climate change. To cite an example, in China, approximately 40% of the energy consumption in the public sector comes from higher education alone. Keeping in view of this data our expansion of educational activities will enhance our energy consumption while we try to move from the current global enrolment rate of 38% to 100%. In addition, the globalization of education, specifically in the domain of higher education has given rise to students' mobility. It is also contributing for carbon emissions. The contribution for carbon emission on account of student mobility is estimated to be around 14 megatons of CO₂ per year which is likely to increase as campus-based learning is the dominant mode (Kanwar and Carr, 2019).

- **Emerging realization for Carbon Neutral Education**

Concept of Carbon Neutral Education (CNE) has emerged primarily due to the concerns for climate change. Educational Institutions' role for carbon neutrality is coming up in two ways. Educational Institutions are increasingly becoming cautious about GHG emissions due to their activities (Baumber et al,2019). Institutions are gradually adopting low carbon practices and trying to ensure provision of educational services in a manner that there will be no net increase of greenhouse gas concentration in atmosphere. They are gradually moving towards low carbon practices (e.g., carbon reduction, carbon offsetting etc.) and thereby trying to become carbon neutral institutions. Secondly these institutions are adopting appropriate curricula, pedagogical approaches and sustainable actions via teaching and research to educate their students about carbon neutrality.

- **Vulnerabilities of Educational Infrastructure**

Climate change and its associated impacts can disrupt the normal functioning of education systems as floods or storms, for instance, can destroy educational institutions or cause disruptions to school terms or years. It can drastically impact the developing countries where educational systems are already in poor shape. However, the educational systems and climate change have complex interdependence. A weak educational system cannot effectively deal with climate changes and poorly managed climate change will further put educational infrastructure in to risk (COL). Though a well-developed educational system is vital to address the issues of climate change, it also negatively and disproportionately gets affected by such changes. On the other hand, climate change also has major, detrimental impacts on educational systems. Entire schools can be destroyed or irreparably damaged, leading to thousands of displaced students, unable to continue their education. Critical data and student records may be wiped out entirely, leading to the collapse of entire systems (Kanwar and Carr, 2019). According to UNICEF, more than 3000 classrooms and over 330,000 students were affected when Cyclone Idai, hit eastern Mozambique. Hurricane Dorian destroyed 90% of the infrastructure in the Bahamas. The week after Hurricane Dorian hit was to be the first week of school and many families had paid school fees and purchased uniforms, which were lost and many schools were deemed to be unsafe for students (COL). Hence the role of educational systems within the overall context of climate change is multi-dimensional. This unit will give you a perspective to understand the critical interdependence between the two.

15.5 NEED FOR CURRICULUM CHANGES

Climate change involves deep complexities, interconnectedness across disciplinary boundaries and impacts beyond political and geographical boundaries. Its predictions for future still bear different levels of uncertainties. Even today several people doubt whether climate change really exists. Research literature refers climate change as a wicked problem and often a super wicked problem. Such a scenario makes climate change education a challenging task and calls for paradigmatic changes in our approach. It should seek to answer the following question: How to educate people for transformation towards a sustainable future? What kind of change in thinking and action is needed? And what kind of pedagogical approaches are required? (Lehtonen, Salonen and Cantell, 2019).

- **Public Awareness: Important Issues**

Climate Change requires a massive change in the current habits and behaviors of individuals, communities, regions and nations. It is not possible without education. Several countries have started major awareness programs to sensitize the general public about climate changes. The sensitization programs have been launched at several levels, for example individual level, local level, national level and global level. However, the awareness programs

in different countries have not yet yielded desired results. There are certain deep-rooted intricacies of these issues which you must understand. It is now well realized that climate change education has to be understood in the right perspective. Educational interventions just on the basis of knowledge acquisition will not lead to desired changes in the habits and behaviors. However, there is yet to develop the right perspectives for climate education. A study carried out by UNESCO reveals that public awareness is most common commitments made for climate change education in most of the countries. It is evident in their national submissions and future plans nationally determined contributions (UNESCO, 2019)

- **Interconnectedness: The ultimate aim of climate change education**

Linear modern and fragmented thinking cannot work in the context of wicked problems. Our thinking based on dichotomies is at the root of such problems. In fact, such a world view promotes unsustainability and resulted in to geological era of Anthropocene. Awareness of interconnectedness is missing in our approach of climate change education. Different subjects are looking at climate change education from entirely different perspectives, methods and concepts. Quite often, the teaching in schools is organized in to subject oriented structures with no interconnectedness between them (Lehtonen, Salonen and Cantell, 2019). There is a need to bring about holistic and systemic understanding of the world. Climate education programs have to imbibe this feature in curriculum planning.

- **Need to go beyond discipline-based knowledge**

Traditionally, “Higher Education” is generally compartmentalized in to highly specialized areas of knowledge and traditional disciplines. Climate change related issues have been linked only to science subjects which have given only lopsided view of the climate change education. In fact, climate change is a wicked problem which means it is a complex, interconnected, has multiple causes and suffers from scientific uncertainty (Davidson and Lyth 2012). Therefore, climate change education calls for an integrated and interdisciplinary approach. Different disciplines have much to offer for climate change education. However, several complex interactions between social, economic and environmental domains of human life are the most complex and interdependent issues with which society must deal. These issues cannot be addressed through a lopsided perspective of disciplinary knowledge. Exact solutions about the issues of sustainability can be found across the disciplinary boundaries. Therefore, sustainable human future would require a paradigm shift toward a systemic perspective emphasizing collaboration and cooperation. Much of higher education stresses individual learning and competition, resulting in professionals who are ill prepared for cooperative efforts. Learning is fragmented, and faculty, responding to long-established incentives (e.g., tenure, research) and professional practices, are often discouraged from extending their work into other disciplines or inviting interdisciplinary collaboration. The CCESD therefore calls for inputs for

teaching, research and extension from all the disciplines. Such integrated perspective will give an understanding of underlying social, economic, and political causes of climate change and priorities for transformation.

- **Addressing local and global perspectives on climate change**

As the climate related problems and its consequences are getting aggravated, there is a dire need to build capacities at individual, local, national and global level. Besides localized behavior and actions can have impacts at the global level and people need to be capacitated to identify solutions at local, national, regional, and global Levels. The situation is challenging primarily because of the complexities involved in climate change. There is significant research evidence to believe that climate change has strong bearing on apparently unrelated issues like global poverty, social inequality, biodiversity loss, natural resource depletion etc. Climate change is cause and consequence of such issues. It makes climate change truly a multidimensional problem. There cannot be a single prescription for resolving this problem. There is a dire need to explore new knowledge to address such complex interrelationship between climate change and social, economic and environmental dimensions (Stephens et al, 2008). The solution has to be multidimensional and should involve several social, economic and environmental factors.

Check Your Progress 1

Note: i) Use the space given below for your answers.

ii) Check your answers with those given at the end of the unit.

1) Why education is needed for dealing with climate change?

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2) Should there be any change in conventional ways of education? If yes, then explain why?

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15.6 FLEXIBILITY AND INNOVATIVENESS: HALLMARKS FOR CLIMATE CHANGE EDUCATION

Climate Change Education for Sustainable Development (CCESD) need to be transformative in nature, interdisciplinary and should promote action competencies. It should not be limited to transfer of just knowledge and skills, if it has to meaningfully contribute for mitigation and adaptation efforts on climate change. The higher education sector is favorably placed to take a lead in this direction through appropriate changes in curricula and delivery; research; community outreach; and carbon sensitive campus operations. As the concerns for Sustainable Development Goals have picked up systems of “Higher Education” are coming to prominence in the policy making circles. There is an increasing realization across the world that “higher education institutions bear moral responsibility to increase awareness, knowledge, skills, and values needed to create a just and sustainable future” (Cortese, 2003). In this context open universities, due to their innovative ways of program production and delivery have come to forefront of national agendas particularly in developing countries where target groups suffer from multiple vulnerabilities and depend on climate sensitive livelihoods. In several developing countries, open universities have started making a perceptible impact in the developmental scenarios. Paradigmatically new ways of Curriculum Development, Program Delivery and Community Outreach Programs have become popular in developing countries. The grass-root priorities are increasingly finding a place in the policy environments of Open Universities.

The conventional systems of “Higher Education” can no longer meet these challenges because of its rigid and straight-jacketed approach. There is an urgent need to make major structural changes in “Higher Education”. These issues have been well realized in the formulation of post 2015 development agenda of United Nations. The Higher Education Institutions are now gearing up their systems and processes to creatively align with the requirements with Sustainable Development (Second Nature, 2016). The need for innovative and flexible “Higher Education” has now come to forefront of the global debate for sustainable development. The SDG-4 has specially highlighted the new roles of “Higher Education”. The policy environment of Higher Education will be the key to unlock the potential of Higher Education to address these challenges. Moreover, all the methods of delivery i.e. formal, informal and non-formal education should be explored to reach out to diverse target groups. Any single mode of delivery will not be sufficient to cover every target group. There is also a realization that technology can open up enormous possibilities for climate change education.

The technology enabled systems have emerged as an opportunity to enhance the reach of capacity building programs for climate change. The usefulness of such programs can be understood in the context of Paris Message, which

calls on Governments as follows: “*We call on Governments to recognize the important contribution of Online, Open and Flexible systems to meet the challenge of scale and quality in the provision of Higher Education and Lifelong Learning for the period 2015-2030*”. (The Paris Message, UNESCO, June 2015).

In this context MOOCs have a vital role to play. Since their origin in 2008, MOOCs have attracted attention of educational planners, to educate diverse target groups who cannot join conventional systems of education due to various reasons. The usefulness of MOOCs as educative tool for climate change awareness and literacy has given rise to CC-MOOCs (Climate Change-Massive Open Online Courses). There is a widespread agreement about the usefulness of using MOOCs for climate change capacity building largely because of unique characteristics of target groups. The climate change is a cross border phenomenon and therefore the online educational platforms are an ideal way to address these requirements. MOOC has a potential to connect people from multiple social and cultural locations, bring them on a common interactive platform and thereby deliver programs on the issue of common concern. They have special relevance for both developed and developing countries. Where as in developing countries, the need for MOOC primarily arises from livelihood commitments of the target groups, shortage of infrastructure, shortage of academic expertise and spiral cost of infrastructure for conventional education, in developed countries the requirements ideally stem from the increasing number of people participating in work force.

Number of such MOOCs have been consistently increasing. Their contents are spread over diverse themes like knowledge, literacy and awareness on climate change issues, topics such as the science of climate change, economics of climate change, politics of climate change, or sociology of climate change etc. It has been observed that the major initiatives for CC-MOOCs have come from universities. However, some were developed by private companies and non-governmental agencies, such as United Nations Environment Program or World Wildlife Fund. The contributors of CC-MOOCs have been uneven across different countries. Within the countries category, the USA was the largest contributor of CC-MOOCs. The reason is quite understandable as MOOCs were initially developed in North American Universities. However, CC-MOOCs have also been developed by large number of universities, and other institutions from Europe (in France, Netherland, Portugal, Sweden, Switzerland, United Kingdom), as well from Asia, South Africa, Latin America and the Caribbean. Most of these courses aimed at large and unspecified audiences. Very few of them specified their target population such as under graduate students, scientist or decision makers. Among the CC-MOOCs some were specifically designed to support the United Nations Framework Convention on Climate Change at the 21st conference of the Parties (COP21), where the Paris Agreement was signed in December of 2015.

Check Your Progress 2

Note: i) Use the space given below for your answers.

ii) Check your answers with those given at the end of the unit.

1) Why interdisciplinary approach is inevitable for the climate education?

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2) In what way Open and Distance Learning systems are advantageously placed to address the concerns for climate change?

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15.7 CAPACITY BUILDING: INTERNATIONAL CONCERNS

The concept of “Capacity Building” does not have any well accepted or tested body of theory. However, this concept has developed with the rising international development cooperation since 1950 alongside the concepts of ‘institution building’, ‘institutional strengthening’, ‘human resource development’, ‘institutional economics’, etc. There has been a popular notion during post World War II period that differences in economic growth and development among developing countries can be explained by the differing quality of institutions responsible for economic management and therefore development could be pursued through building and strengthening national institutions. The focus was therefore on institution building and institutional strengthening though such a notion did not attract any research support within the international development community. Even the Universities which have been traditionally engaged in generation of ideas and knowledge, they have not developed any significant theoretical basis for the idea of “Capacity Building”. The concept of Capacity Building came up in early 1990s in international development domain largely with the initiation of World Bank. However later on development agencies started using the concept of ‘capacity development’ without much of the difference between the two terms, though there is a lack of consensus on what capacity building/development actually means. However there appears to be a consensus that capacity building must include individuals, institutions and

systems that collectively enable effective and sustainable development (ECBI, 2017).

“Capacity Building can be defined as the ability to perform tasks and produce outputs, to define and solve problems, and make informed choices” (EuropeAid, 2007). The agenda 21 of United Nations Conference on Environment and Development (UNCED,1992) talks about the relevance of country context and assessment of local needs for appropriate capacity building action: *“Specifically, capacity building encompasses the country’s human, scientific, technological, organizational, institutional and resource capabilities. A fundamental goal of capacity building is to enhance the ability to evaluate and address the crucial questions related to policy choices and modes of implementation among development options, based on an understanding of environment potentials and limits and of needs perceived by the people of the country concerned”* (UNCED,1992)

15.7.1 Capacity Building in the Context of UNFCCC

There have been several capacity building initiatives within the context of UNFCCC (the convention). Capacity building is also undertaken by different international organizations and institutions, UN agencies, academia and civil society through different projects and initiatives. Most of these initiatives are bilateral and multilateral efforts, both within and outside the Convention. Within UNFCCC there are more than 12 thematic bodies and operating entities which undertake capacity building activities ranging from workshops to e-learning modules, thematic dialogues, technical advice and support for strengthened institutional policies and frameworks in developing countries. Framework for Capacity Building in Developing Countries, agreed to as part of the Marrakesh Accords at COP 7 in 2001 is the guiding framework for capacity building in developing countries. The initiatives for capacity building within the UNFCCC are well documented. The efforts are compiled in annual synthesis reports, prepared each year by the UNFCCC secretariat. They are also reviewed comprehensively by the Subsidiary Body for Implementation (SBI) every five years. There are also platforms like Durban Forum on Capacity Building and the Capacity-Building Portal for lesson sharing and dissemination of information among Parties, civil society, academia and international organizations. However, despite the considerable multilateral and bilateral efforts under the UNFCCC, the developing countries still face several capacity building challenges which jeopardize their ability to carry out climate action.

15.7.2 International Cooperation

The requirements for capacity building have emerged in different countries as per their socioeconomic context. Different countries are neither at same level of development nor do they have same level of capabilities which is a major constraint for building a low carbon and climate resilient world in an equitable fashion. There has been a felt need for greater level playing field

for developing countries in UN Framework Convention on Climate Change (UNFCCC). Unfortunately, many developing countries still need expertise to articulate the climate related issues of their countries to negotiate on international platforms.

However, there is a serious lack of senior negotiators in developing countries. Further there is an effective communication block between senior negotiators from developed and developing countries. As the climate change issues are getting aggravated, the developing countries will need capable negotiators to defend their positions on international platforms. This is the reason why European Capacity Building Initiative (ECBI) adopted a two-pronged strategy in UNFCCC. The first part of such a strategy involved developing training programs for new negotiators from developing countries (particularly from least developed countries). It was felt necessary because climate change negotiations are often technical and complex and it is difficult for new negotiators to understand their intricacies easily. Second part of strategy aimed to create opportunities for senior negotiators from such countries to interact with their European counterparts. It was intended to create informal spaces for a greater degree of appreciation about each other's positions, discuss their differences and build mutual trust among them.

15.7.3 Towards a New Paradigm of Capacity Building

The developing countries have always lacked the capacities to handle the climate change. This is one of the reasons why there has been a felt need to develop capacities at various levels. It poses a serious challenge as the most vulnerable communities in such countries are mostly dependent upon climate sensitive livelihoods, live in geographically isolated regions and are outside the institutional framework for capacity building. Though the capacity building initiatives have long been taken by developed countries, such initiatives have fulfilled a limited purpose, which consisted of developed countries allocating funds either through their respective bilateral aid agencies or UN Agencies or multilateral development banks for supporting capacity building in developing countries. Such mediating agencies used international experts as “parachute” to the developing countries for a short time to carry out capacity building workshops in those countries. Developed countries were quite happy with such paradigm of supporting developing countries through consultant driven support. However, such a model of “*fly-in and fly-out*” model for building up capacities had failed to make any significant long-term impact in developing countries. The amounts of funding, the channels for delivery and the beneficiaries were decided by the developed country. There has been a feeling for enhanced support and monitoring of such support mechanisms through appropriate institutional arrangements. Such feelings among the developing countries were not without any reason. Post-2020 international climate regime calls for significant emission reduction efforts and simultaneously increasing

resilience to climate change. However, countries are at different stages of development and capacities. Developing countries are specially disadvantaged due to poor capacities at different levels. This is a major hindrance in the process of building a carbon resilient world in an equitable way. Effective capacities at different levels will enable developing countries to contribute for global efforts to reduce emissions and adaptation to climate change which requires enhanced, strategic and sustained approaches for capacity building and education. There is a need to strengthen the Institutional Architecture for Capacity Building in these countries. Despite the fact that several multilateral and bilateral initiatives have already been taken, most developing countries continue to face significant capacity challenges which undermines their ability to effectively or fully carry out the intended climate actions. Public awareness and support for climate action within these countries is limited. Existing information base, research expertise and training in assessment approaches and methodologies is limited. There is a lack of strong policy environment and processes needed to effectively plan, manage and coordinate capacity building activities. These challenges have continued to persist over a period of time. The support for capacity building from international institutions has been ad hoc extended through short-term project-based approach. Moreover, there has not been coherent centralized institution, regular monitoring and review processes in place to ensure sustained and long-term capacity at the institutional and systemic levels. Hence there is a need to improve institutional architecture, improving monitoring, analysis, and review of capacity-building activities and fostering cooperation at international, national, sub-national, and regional levels. The matter of capacity building has come to the forefront of international agenda with the advent of Paris agreement.

15.7.4 Paris Agreement and Capacity Building

Paris agreement's basic premise is the participation of all which necessitates the capacity building at all the levels. It provides an opportunity to build the capacities needed to mitigate and adapt to climate change. Paris agreement has set a roadmap for capacity building by establishing the Paris Committee in Capacity Building (PCCB). This committee has objective to develop comprehensive work program including identification of capacity gaps and needs, to develop cooperation at international, regional, national, and sub-national levels, to enhance synergies, coordination, collaboration, and coherence among existing bodies and activities within and outside the UNFCCC, to promote development and dissemination of relevant tools and methodologies and lastly to develop systems for collection of best practices and lessons learned, with a goal of enhancing ownership and retention of capacity at national, regional, and sub-national levels.

The issue got attention of the international community during pre-negotiations during Paris Agreement. Developing countries raised serious concerns for changing prevailing paradigm. The argument for need of

paradigmatic changes in prevailing practices were accepted and Paris Agreement adopted Article 11 on Capacity Building which supports the need for every country to develop in-country sustainable capacity building systems and no longer depending on international consultants forever. It was also felt that there was a need to oversee capacity building initiatives. Therefore, Paris Committee on Capacity Building (PCCB) was formed having equal representation from developed and developing countries. Several new initiatives were taken to involve Universities as well as other think tanks from developed and developing countries e.g., University Network on Capacity for Climate Change (UNCCC) and the LDC Universities Consortium on Climate Change (LUCCC). A major challenge is to measure capacity building at national level. Here are different ways to categorize it. The first step is to raise awareness about climate change. For instance, among developing countries, Bangladesh has a high level of awareness as many people are familiar about the word climate change. This can be called first level of capacity building. As a further step there is a need for knowledge of solutions. As a one more step further, each stakeholder group should also know what kind of role they are expected to play to tackle adaptation and mitigation of climate change. For instance, the role of government officials from different ministries, NGOs, private sector, media or academia will be different. Each such group have to be capacitated on their respective roles.

Check Your Progress 3

Note: i) Use the space given below for your answers.

ii) Check your answers with those given at the end of the unit.

- 1) How does the poor capacities in different developing countries adversely affect the interests of developed countries?

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- 2) What are the concerns shown in Paris Agreement for capacity building in developing countries?

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15.8 CASE STUDIES

Case Study 1: Learning Sustainable Development with Mobile Devices (Chen and Hsu, 2007)

The theory of situation cognition emphasizes that the instruction for conceptual knowledge is most effective when embedded in a physical and social environment. Therefore, complex environmental issues can be best learnt through effective engagement of students in real life situations. The students effectively connect such field experience to the theoretical concepts of sustainable development learned in classrooms. Technological advancement of mobile devices has opened up new possibilities to create learning environments outside the classrooms. A case study conducted by Chen and Hsu provides useful insights about the use of mobile devices in learning sustainable development. The study involved the students in a field trip to local historical ditch to study a mobile learning module. Eight high school teachers and 14 tenth-grade students participated in the self-guiding field trip. Every student was provided a Pocket Fieldwork Assistant (PFA) developed with mobile technology. The device was configured to conduct the field trip without the company of teachers hence reducing the cost of a field trip. The Pocket Fieldwork Assistant (PFA) served two main functions, namely, route guide and learning support. The route guide provides details about the pre-defined field spots in the study area and provide information about transport route for each spot. The learning support component of PFA adopts inquiry-guided pedagogy and enables the students to be active learners. The device also gives access to reading resources and a local map of the irrigation ditch to facilitate them to answer field-based questions. Students were guided by the mobile device to visit 5 waypoints showing various land-use types upon the ditch. Students were asked to collect field data and interview local residents to evaluate 3 scenarios regarding the future development of the Liugong irrigation ditch, a historical heritage ditch in Taipei metropolis. The students found such learning activities interesting and felt highly confident to solve the field problems themselves with the help of advanced technology. Both teachers and students confirmed that module was helpful to students to study local environmental issues as well as the concepts of sustainable development.

Case Study 2: Creating awareness of food safety and climate change through mobile learning (Vijayakumar, Venkatramanan and Salooja, 2015)

As concerns for climate change are rising, the food safety and food security have emerged as major challenge. The potential impact of climate change on food safety includes increased ability of fungi to produce mycotoxins, emergence of virulent pathogens, stress induced microbial evolution, increased use of pesticides and decreased water availability driven food spoilage. There is need of capacity building at various levels and applied research on food safety to mitigate the risks associated with food spoilage.

The demand for awareness building is huge and cannot be met solely through conventional ways of education. Open and Distance Learning systems, due to its innovative and flexible nature, can prove to be cost effective for a wider and larger level of coverage. As the mobile penetration is increasing, there is a new opportunity to launch capacity building programs in a cost-effective manner. The mobile learning can involve the use of mobile technology either alone or in combination with other ICT to enable learning anytime and anywhere. It is the delivery of tailored learning contents and learning support on mobile phones, tablets, notebooks. Development of mobile applications in different mobile operating systems like android, iOS, Windows etc. can help in creating awareness as well as stimulating critical thinking. Triggering critical thinking can be done by providing contents like Scramble, crossword, brain games, puzzles, cartoons etc.

Case Study 3: Scalable online capacity-building for heterogeneous, geographically dispersed communities (Wolf et al, 2016)

Though energy drives development in all the countries, SIDS have some unique problems related to energy sector. Most of the SIDS, have a heavy reliance on non-renewable energy supplies (i.e. oil and gas). They have to import such energy resources at a high cost, despite having a large potential for the production of renewable energy, availability and cost-effectiveness of energy efficiency technologies. Lack of skilled human resources in energy sector is one of the major obstacles to the uptake of renewable and energy efficient technologies. They create structural barriers to a sustainable development path in these countries. The unmanaged energy sector can have detrimental impacts of long-term climate change. Therefore, human capacity-building in particular has been identified as a key socio-economic driver in SIDS which are already confronting with poor socio-economic conditions. The poor socio-economic status of these countries is another major hassle for creating training infrastructure. It is difficult to create conventional classroom based educational systems for the capacity building primarily because of geographical isolation, remoteness of the islands and job commitments of target groups. Development of online interactive platforms can create innovative and flexible learning environment for the learners. Such collaborative, interactive learning formats can promote education for sustainability and address the chronic human capacity problem that constrains the quicker uptake of sustainable energy technologies in geographically inaccessible and remote locations. These online platforms have been used to design innovative capacity building programs for the energy sector in SIDS. Geographic features of Small Island states make them especially vulnerable to short-term climate variability. Their energy related training requirements cannot be effectively met through conventional ways of capacity building. Such countries need this training to achieve Sustainable Development Goals (SDG) and to reduce energy poverty. Online learning can facilitate innovative formats of practice centered trainings which can effectively address local needs and helped overcome geographical constraints

of remote islands. Hamburg University of Applied Sciences has taken an innovative initiative to develop a MOOC to build up the capacities of energy practitioners in such countries. The initiative has given rise to tremendous enthusiasm in target communities and effectively matches their aspirations.

Case Study 4: Improving Livelihoods and Mitigating Climate Change in Mexico's Forest Communities (Source: World Bank, 2019)

Ever since the Paris Climate Agreement came in to force, the global support for forest-based climate change mitigation and adaptation measures has increased. In 2012, Mexico pledged to bring an end to deforestation in the country and reduce its greenhouse gas emissions by 22% by the year 2030. The Mexico's forests had been a source of livelihoods for about 12 million poor people who own approximately 61% of the country's 88 million hectares of forests. However, most of these forests are cleared for agriculture or other purposes, leaving the residents unable to reap the benefits of these natural resources. There is a need for policy design and institutional strengthening for cross sector collaborations; technical assistance to the local communities; consolidation of local forestry management programs thereby creating avenues for additional incomes and motivation for reforestation; and to streamline community-based initiatives in early action areas through innovative preventive measures. In order to address these issues Mexico's National Forestry Commission (CONAFOR), the World Bank and FAO developed a Forests and Climate Change Project to promote sustainable, productive forest management strategies. Through project activities the rural communities acquired planning and implementation support to increase forest conservation, production and productivity which significantly contributed for much needed resilience of local communities to climate change, better income opportunities and expansion of community managed forest areas besides reducing deforestation decreased by 25 to 50 percent in project areas. The results have been overwhelming as project's initiatives could help over 1,000 agrarian communities in their efforts to transform over 1.8 million hectares into sustainably-managed forests, creating upwards of 9,000 jobs.

Case Study 5: Using Radio and Television Media to fight Climate Change: Echoes from Ghana (Source: COL Web Site)

This study was carried out to examine the role of diverse forms of media to fight climate change. It concluded that mass media can create an effective knowledge base of individuals to make informed decisions, develop their skills and empower them to ensure a sustainable change. The study was carried out in Southern Ghana (a part of Central region) where a sample of 500 adult audiences (ten people from each of the fifty communities) of 15 radios and television stations were randomly selected to participate in this study. The sample population was interviewed in their homes at the start of the study and their knowledge level on climate change effect was recorded. For three months open learning sessions were organized in local language through video, television, radio and social media. The study was set up in a

double-blind fashion to reduce the risk of any bias. Initially, 12% of the sample population could only state that climate change can directly affect water and oceans and there was nothing they could do. They were not aware that an assessment would be taken orally at the end of the survey period. Assessment at the end of the study period showed 80% of the population was able to state correctly the five components of the environment directly affected by climate change. Also, 65% argued that the human population could reduce the effects easily with community education, organization, and resources mobilization. 73% formed climate change clubs in their communities during the period. These clubs had become focal points for organizing community initiatives for local developmental initiatives. The communities have been empowered sufficiently by the research study, having built their capacity to demand environmental justice assurance from agencies and people, which hitherto have been degrading the environment in such communities.

15.9 LET US SUM UP

Issues of 'Climate Education' and 'Capacity building' have got renewed attention with the launch of Sustainable Development Goals (SDGs). These goals emphasize for climate education-under their targets 4.7, 12.8 and 13.3, and their global indicators. Further, article 12 of the Paris Agreement calls for effective mechanisms for climate change education, training, public awareness, public participation and public access to information.

It is now well realized and understood that, the role of education to deal with climate change requires paradigmatically different approaches. The business-as-usual approach of educational systems will not work. Climate change not only poses dangers for entire planet but it also offers enormous opportunities that arise by adopting solutions to it (UNFCCC, n.d, b). These opportunities cannot be realized without building capacities of the developing countries. In this context innovative and flexible systems of capacity building are gaining prominence across the world.

15.10 KEY WORDS

Capacity Building: It can be defined as the ability to perform tasks and produce outputs, to define and solve problems, and make informed choices.

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15.12 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

- 1) Refer to section 15.4
- 2) Refer to section 15.5

Check Your Progress 2

- 1) Refer to section 15.5
- 2) Refer to section 15.6

Check Your Progress 3

- 1) Refer to section 15.7.3
- 2) Refer to section 15.7.4

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UNIT 16 CLIMATE CHANGE POLICY

Structure

- 16.1 Introduction
- 16.2 Objectives
- 16.3 History of Climate Change Debate
 - 16.3.1 First Phase: The Emergence of Scientific Consensus
 - 16.3.2 Second Phase: Agenda Setting
 - 16.3.3 Third Phase: Early International Responses
 - 16.3.4 Fourth Phase: Negotiation of the FCCC
 - 16.3.5 Fifth Phase: Post-Rio Developments
- 16.4 Kyoto Protocol
- 16.5 Copenhagen Summit 2009
 - 16.5.1 India and Copenhagen Summit
 - 16.5.2 India's Position
 - 16.5.3 Impact of India's Position on the Copenhagen Summit
- 16.6 Paris Agreement
- 16.7 India's Response Framework
- 16.8 National Action Plan on Climate Change
- 16.9 State Governments' Efforts to Address Climate Change: State Action Plan
 - 16.9.1 Tamil Nadu
 - 16.9.2 Delhi
 - 16.9.3 Jharkhand
- 16.10 Assessment of State Action Plans on Climate Change
- 16.11 Let Us Sum Up
- 16.12 Key Words
- 16.13 Suggested Further Reading/References
- 16.14 Answers to Check Your Progress

16.1 INTRODUCTION

“We have the moral responsibility to bequeath to our children a world which is safe, clean and productive, a world which should continue to inspire the human imagination with the immensity of the blue ocean, the loftiness of snow-covered mountains, the green expanse of extensive forests and the silver streams of ancient rivers,” said the former Prime Minister of India, Dr. Manmohan Singh.

developed countries. Moreover, the debates on climate change are helping to build up a comprehensive climate change regime with a country-specific action plan. The climate change management at the international level consists of the 1992 United Nations Framework Convention on Climate Change (UNFCCC), 1997 Kyoto Protocol and the decisions taken by the signatory countries under these instruments. Even though, it was considered as a first step to address climate change and its consequences, it was not sufficient to force member States to take appropriate actions to address climate change with rapid change in environment and rising temperature. It was widely considered an inadequate instrument to combat climate change. Both the UNFCCC and Kyoto Protocol did not contain the necessary clauses to mitigate greenhouse gases (GHG) emissions, which resulted in a lack of binding obligation for developing countries. Some of the developing countries withdrew from the Kyoto protocol in the second commitment period. Hence, Parties to the UNFCCC came together and formed an Ad-Hoc Working Group at the Durban Conference in 2011. It was called as Durban Platform for Enhanced Action (ADP) to negotiate a new climate agreement by 2015 that would come into force from 2020. The four years of continuous negotiating process resulted in the formulation of the 2015 Paris Agreement, which was expected to govern, regulate and incentivise the next generation of climate actions. With this introduction, through this unit, we will discuss Copenhagen Summit; Paris Agreement; National Action Plan on Climate Change (India) and State's Action Plan in India.

16.2 OBJECTIVES

After studying this unit, you should be able to:

- discuss the history of climate change debate;
- explain the significance of Kyoto Protocol and Paris Agreement on Climate Change;
- describe Copenhagen summit 2009 and India's position in Copenhagen Summit;
- describe National Action Plan on Climate Change; and
- examine the efforts of state governments in India to address climate change related issues.

16.3 HISTORY OF CLIMATE CHANGE DEBATE

Climate change as an environmental fact has begun to be felt in the year 1987 with the release of the Brundtland Commission report, *Our Common Future*. The report highlighted the issues such as depletion of ozone layer, loss of biological diversity and the rising greenhouse gas concentration and argued for achieving sustainability by formulating effective socio-economic policies. The development of global climate change regime can be divided into five phases prior to the Kyoto protocol. The five periods are as follows;

- The foundational period expresses scientific concern about global warming.
- The agenda-setting phase (1985-88) intended to transform the scientific concern into policy matter.
- Pre-negotiation period (1988-1990) involved government in the process of climate change regime
- The formal intergovernmental negotiation (1992) impressed upon the adoption of FCCC by May, 1992
- The post-agreement phase focused on the elaboration and implementation of FCCC and the adoption of Kyoto commitments.

16.3.1 First Phase: The Emergence of Scientific Consensus

In the early 1960s, the increasing atmospheric concentration of greenhouse gas was published by the scientists from Mauna Loa, Hawaii to establish climate change as a scientific fact. The 1979 report of the National Academy of Science evaluated the existing models of the atmosphere and concluded that the increase of carbon dioxide in the atmosphere will lead to future climate change. By the mid-1980s, scientists opined that anthropogenic emission of gases like methane and nitrous oxide are also cause of concern.

16.3.2 Second Phase: Agenda Setting

The accumulation of scientific knowledge has significantly contributed towards forming both public and political opinion on the issues of climate change. Scientists across the world worked to push climate change debate into public. The establishment of the Advisory Group on Greenhouse Gases and the report of the Enquete Commission helped to translate the uncertainties of climate change science into a real-world possibility.

16.3.3 Third Phase: Early International Responses

The establishment of IPCC in 1988 is a landmark in climate change debate. The IPCC has produced comprehensive assessment reports in 1990, 1995, 2001, 2007, 2014, and 1.5°C special report in 2018. IPCC reports on the scientific assessment of global warming compelled the governments to initiate strong position with regard to climate change concern. In the Noordwijk meeting, the split occurred amongst the governments of western countries with regard to committing themselves towards addressing the challenges of climate variability. In this context, many European countries had joined the CANZ group in support of imposing quantitative limitations upon the countries to reduce the emission level of greenhouse gas. In contrast, United States and other Western States continued to give emphasis more on having a neutral position than adopting the European model of target-timetable approach in reducing the rate of greenhouse emission. Developing countries showed unity among themselves and agreed to adopt the target-time table approach and shown commitment in promoting

technology transfer to reduce the emission level. As a Plan of Action, various small island states of developing nations formed an alliance and formulate the body, i.e., Alliance of Small Island States (AOSIS) which played a key role to further FCCC negotiations in reducing carbon dioxide emission intensity. On the other hand, the oil producing states critically looked at the science of climate change and argued for adopting a go-slow approach for carbon dioxide emission reduction. Similarly, developing countries like Brazil, India and China emphasized on their right to economic growth and formed a strong opinion to accept the principle of differential responsibility in combating climate change impact.

16.3.4 Fourth Phase: Negotiation of the FCCC

In the year 1990, the UN General Assembly established the body, i.e., Intergovernmental Negotiating Committee for a Framework Convention on Climate Change (INC/FCCC) with specific emphasis on imposing appropriate commitments upon the countries. The primary principles included in the Convention were as follows:

- 1) **Target and Time tables:** The European Union and AOSIS advocated to follow target and timetable approach to limit the emission level.
- 2) **Financial Assistance and Transfer of Technology:** The developing countries demanded for creating a new fund towards helping developing countries in implementing the Convention.
- 3) **Institution and Implementation Mechanisms:** OECD countries including United States advocated to establish implementation machineries including scientific body, deliberate meetings, reporting, and monitoring of the implementation work to tackle the climate change problem.

16.3.5 Fifth Phase: Post-Rio Developments

UN conference on Environment and Development at Rio deliberated on issues like global climate change, biological diversity, deforestation and desertification and many treaties and agreements were signed. And it also stressed that the nation's future policies on economic development should be drafted by considering the environmental implications of socio-economic development. Agenda 21 was a special product of this conference which is also known as Earth summit. The Earth Summit led to the formation of United Nations Framework Convention on Climate Change (UNFCCC). The UN Framework Convention on Climate Change is a treaty signed by 192 countries. It does not set any binding targets on countries for cutting emissions. It only calls for stabilizing carbon emissions. But it set in motion international negotiations for settling the issue of who will cut and how much. The parties to the convention have met annually from 1995 onwards in conference of parties (COP). The Conference of the Parties is the governing body of the Convention, and advances implementation of the Convention

through the decisions it takes at its periodic meetings.

The Convention entered into force in the Berlin conference in the year 1994 to elaborate and implement the commitments to address climate change problem. The Berlin meeting had the following objectives:

- To establish an ad hoc committee to negotiate a protocol;
- To initiate joint-activities among the participating countries to carry out a survey;
- To use Global Environment Facility as the FCCC's financial mechanism; and
- To locate FCCC permanent office at Bonn.

Broadly, the negotiations in relation to climate change were subscribed to two major concerns such as: Emission-target limitations for developed nations; and establishing different mechanisms for developed nations to meet the targets. The climate change debate needs to address the issue of equity not only in relation to the future generation but also in relation to the present generation. In response to the challenge, the international community phrased the common but differentiated responsibility (CBDR) principle as the guiding principle of climate change science.

16.4 KYOTO PROTOCOL

The Kyoto protocol was adopted on December 11, 1997 at the Kyoto. It came into force in February 2005. Under the protocol, 39 industrialized countries, Annexure I countries, committed themselves to reducing the emissions by 5.2 per cent of the 1990 levels by 2012. The Kyoto Protocol was formulated on the basic principle of CBDR and specified that industrialized countries will have to take lead in the process of reduction of greenhouse gas emission. The Kyoto mechanisms include three strategies to reduce emission level such as Joint Implementation (JI), The Clean Development Mechanisms (CDM) and Emission Trading. The Kyoto protocol also assists countries in adapting to the adverse effects of climate change. It facilitates the development and deployment of techniques that can help increase resilience to the impacts of climate change. The adaptation fund was established to finance adaptation projects and programmes in developing countries that are parties to the Kyoto protocol. The fund is financed mainly with the share of proceeds from Clean Development Mechanism project activities. Kyoto protocol applies to industrial nations only. Developing countries like India and China were not required to commit to reductions because their per capita GHG emissions are much lower than those of developed nations.

The commitments included in the Kyoto protocol ranged from developing national inventories/strategies of greenhouse gas emissions, formulating and implementing national level programs with regard to mitigation and adaptation strategies of climate change, promoting and cooperating the

transfer of sustainable technology, promoting sustainable and integrated development, cooperating in preparing adaptation plans, promoting and supporting scientific research and promoting education, training and public awareness about the effect of climate change (Atapattu 2008). In the year 2001, the protocol suffered major setback because US refused to ratify which is producing 36.1 % of the carbon dioxide emission. EU and Japan supported the protocol and ratified it. Reluctance supporters are US, Australia, Russia and Canada. The major shortcomings of the Kyoto protocol are:

- Excluding developing countries from the protocol. This will reduce the effectiveness of the agreement.
- Exclusion of India and China which constitute 36% of world's population and both countries are growing economy.
- Using of older, outdated and environmentally unfriendly technologies by the developing countries, which are excluded from the Kyoto protocol.
- Growing unchecked developing countries emission.
- The Kyoto protocol only raises the awareness and not in real terms.

16.5 COPENHAGEN SUMMIT 2009

The mandate of the 15th Conference of Parties (COP) in Copenhagen is to enhance long term cooperation on climate change under the Bali action plan. The Copenhagen summit was convened to negotiate post-Kyoto protocol agreement at the UN Framework Convention on Climate Change (UNFCCC) to sign a legally binding deal. The Bali action plan in the year 2007 laid a roadmap for the post-Kyoto Protocol agreement for developed countries (Annexure 1 parties in the convention) to reduce greenhouse gases (GHG) emission and assist developing countries to adapt climate change. The developed countries also agreed to help developing countries by transferring their technology to make them to adopt low carbon emission path way. The Bali climate convention has agreed two track negotiations: 1. “working group for long-term cooperative action”, 2. “working group on Kyoto protocol”.

IPCC set the targets for the Copenhagen negotiations. According to them, the GHG emissions will increase enormously by 2015 and then decline by 25-40% over 1990 level by 2020 and will reduce by 80 % over 1990 by 2050 to stabilize carbon dioxide concentration at 450ppm to limit the global warming below 2⁰C (IPCC 2007). The analysis of World Resource institute shows that the commitments announced so far by rich countries may add up to only 13-19 % emission reduction whereas according to IPCC, 25-40 % reduction is needed (Levin and Bradley, 2009). According to the study by International Energy Agency, limiting global warming to 2⁰C with the carbon dioxide concentration limited to 450ppm is feasible, only if the world is ready to invest in low carbon technologies. The key issues discussed at Copenhagen summit are as follows:

- Making continuous progress in the negotiations of Kyoto protocol.
- Insisting governments to commit mid-term GHG emissions reduction.
- Developing scientific monitoring, reporting and verification methods.
- Funding for adaptation and mitigation.
- Transferring technology to the developing countries.

According to the assessment, even if the carbon dioxide concentration is stabilized at 450 ppm which seems highly unlikely there is 26-78 % of risk of overshooting the 2°C goal (Meinshausen, 2005). The Copenhagen summit has taken into consideration of scientific communities' view on restricting global warming below 2°C. After the debates and the intervention of Island countries and Least Developed Countries, the summit included 1.5°C as a target for future negotiations and considerations. This Copenhagen summit also recognized the need to cooperate in achieving halting of the global and national emissions as soon as possible by keeping the special circumstances of developing countries and the need for economic development and poverty alleviation (Ravindranath, 2010).

Copenhagen green fund was established to support mitigation, adaptation, technology transfer and reducing emissions from deforestation. The accord also agreed to transfer technology by establishing a mechanism to do the same. The developed countries agreed to provide US\$ 30 billion immediately for the period of 2010-2012 and mobilize US\$ 100 billion per year for the developing countries.

16.5.1 India and Copenhagen Summit

The Indian delegations in the Copenhagen Summit have expressed the positive outcome because it does not set the time limit for reducing the GHG emissions. India has to increase fossil fuel-based energy to promote the economic growth. The assumption is that if it increases the fossil fuel energy, it automatically reduces the poverty.

India's expectation from Copenhagen Summit is as follows:

- International cooperation should be there to combat climate change.
- The outcome of the negotiations in the Copenhagen should be fair and equitable. It must be in accordance with the "principle of common but differentiated responsibilities and respective capabilities" as per 1992 Rio declaration.
- Summit should provide a space to accelerate socio-economic development in order to eradicate poverty through ecologically sustainable manner.

16.5.2 India's Position

- 1) India, as a sovereign State totally rejected any form of surveillance or

supervision by international organisations in relation to CO₂ emission reduction within the state, especially to the extent that:

- It did not want financial support from international agencies or organization. It was ready to manage from domestic resources.
 - It was ready to take its own procedure for reduction of CO₂ emissions and the percentage reduction will remain at the discretion of the country.
- 2) The Copenhagen Conference is not a legally binding text. The Copenhagen Conference is only a procedure for improving the existing institutional framework to combat climate change and is not under any circumstances a re-negotiation of it nor can it result in the development of a new framework.
 - 3) The Kyoto Protocol remains the core, adequately binding text at international level, and consequently it was not considered necessary to prepare a new text. The only subject for debate is determination of new restrictions on the quantity of CO₂ emissions for developed countries and the setting of a new time period for achieving those targets after 2010.
 - 4) As mentioned earlier, the developed economies are responsible for the phenomenon of underdevelopment in the global system. As a consequence, it is for certain that the responsibility of the developed countries to actively support sustainable development in developing countries by transferring economic resources and technology without enforcing conditions of any sort, such as patents or copyright. The parties responsible for the underdevelopment cannot set conditions.
 - 5) It is unfair to impose emission norms to all industries at global level on issues relating to sectoral emission reduction policies. In other words, the types of industries which cause the greatest harm by emitting large quantities of CO₂ must be identified and focus should be given only on those industries.

It may be stated that the “Accord is meant to facilitate the ongoing negotiations in the two tracks in accordance with the principles and provisions of the UNFCCC, the Kyoto Protocol and the Bali Action Plan. The Accord was not adopted by the Conference of Parties but just taken note of. However, the Accord could have value if the areas of convergence reflected in the Accord are used to help the Parties reach agreed outcomes under the UN multilateral negotiations in the two tracks, i.e., the Ad-hoc Working Group on Long Term Cooperative Action and the Ad-hoc Working Group on Kyoto Protocol. The Accord is only an input into the two-track negotiations. The Accord is not /a new track of negotiations or a template for outcomes.”(www.usclimatenetwork.org/policy/copenhagen-accord-commitments#note10).

16.5.3 Impact of India’s Position on the Copenhagen Summit

- 1) India has emerged as regional leader in the SAARC region by strengthening its economy.
- 2) Development of basic block in the conference is the result of India’s aspiration as a regional leader to foster ad hoc partnership.
- 3) It has strengthened its relationship with China.
- 4) The closer ties of India and China on climate change issues are expected to bring multiple impact at the international level.
- 5) India strengthened its position by mobilizing more developing countries to adopt joint position and shape the final conference text. So, the text was not binding. It acted as a powerful member for the economically developing force.
- 6) The role played by the G77 was worth to be noted and India being part of G77 group had a significant influence.
- 7) The conference proceedings showed that the developed countries have split into many and least developed countries took different positions. The island nations had a different position. This affected the outcome of the conference proceedings and the conference could not take specific time frame for implementing the climate change.

Check Your Progress 1

- Note:** i) Use the space given below for your answers.
ii) Check your answers with those given at the end of the unit.

- 1) What are the issues discussed at Copenhagen Summit?
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- 2) List out the expectations of India from Copenhagen Summit.
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16.6 PARIS AGREEMENT

At the Durban Conference (COP 17) an “Ad-Hoc Working Group on the Durban Platform for Enhanced Action” was established “to develop a protocol, another legal instrument or an agreed outcome with legal force under the Convention applicable to all Parties”, by COP 21 so that it can be adopted no later than 2015. The Paris Agreement is the outcome of four-year negotiating process and multilateral diplomacy. Article 2 of the Paris Agreement, states that “in enhancing the implementation of the Convention, including its objective, the agreement aims to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by: (a) Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change; (b) Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production; and (c) Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development”. Paris Agreement entered into force on 4th November, 2016. The main features of the agreement are universal application; the principle of equity and principle of common but differentiated responsibilities and respective capabilities; and “legally binding agreement that will apply to those states that have expressed their consent to be bound by means of ratification, acceptance, approval, or accession”. With respect to our country, the agreement demands India to submit “national contributions” every five years; and to embark on low carbon development pathway.

The successful multilateral diplomacy has brought a historic Paris Agreement to address climate change. The Paris Agreement binds all States that have expressed their consent to be bound by this agreement. Once they accept and approve, they ratify the same and take necessary measures to implement the same by formulating laws, policies and programmes. Any legal character of a provision in the international treaties makes the parties to oblige legally. It also set the standards for States to achieve the obligations within prescribed time period. States need to assess their work in a regular interval and submit reports periodically. This may give clear picture whether states have compliance/non-compliance to the agreed provisions. If we assess Paris Agreement through these lenses, states need to fully oblige mitigation and transparency sections of the Agreement. Unlike mitigation and transparency sections, adaptation sections seem to be soft obligations.

175 countries including India ratified Paris Agreement. As we mentioned earlier, unlike the divisive Kyoto Protocol, all parties required to submit relevant documents with regard to GHG mitigation and adaptation measures to counter adverse effects of climate change as per Paris Agreement at

regular intervals. 189 states/countries covering over 95% of global emissions have submitted nationally determined contributions in the context of Paris Agreement. The Paris Agreement has aspired to address adverse effects of climate change by stabilizing temperature rise ('well below 2°C' and to aspire to 1.5°C). As we mentioned earlier, each state/country must report to their efforts to combat GHG emissions or mitigation measures in every five years.

Agreement provides autonomy to the states/countries to decide on their own to address climate change. But their successive efforts must be progressive one compared to previous ones. There are three important components in the Paris agreement. Firstly, states/countries must take transparent measures to address or mitigate climate change and their agreed contribution. Secondly, there will be global stock taking process which will be assessed periodically to recognize collective progress towards the Agreement's long-term goals. Thirdly, there will be a compliance system that facilitates member states/countries. It was recognized by the previous studies that the measures taken to mitigate and adapt to climate change might affect human rights. First of its kind, Paris Agreement accepted the relationship between climate change and human rights like right to life, right to health, right to food, and right to housing, with marked departure from earlier climate change instruments. It contained explicit reference. In addition to this, states/countries need to formulate necessary laws to improve socio-economic conditions of vulnerable to address human rights issues. Yet, until recently, no legally binding international climate instrument explicitly recognised the existence of intersections between human rights concerns and climate change.

As far as India is concerned, the Paris Agreement requires India to submit its national contribution every five years, ensuring that each contribution is a progression on the previous one. It also requires India to report periodically on its actions to achieve and implement its contribution. In addition, India should 'strive' to submit long-term low-GHG development strategies within which these national contributions will sit. The Paris Agreement makes India to formulate necessary policies to address energy requirements, environment and development. As mentioned earlier, each member states need to submit periodically about their progress. To do the same, India must collect quantitative data rigorously to show the progress. Qualitative data may be helpful to recognize the impact of policies on vulnerable. Although, India was able to reduce poverty among vulnerable considerably over plan period, it needed to take further measures to address poverty and vulnerability in certain geographical areas. The measure taken at this issue must be in a right direction. India has responsibility at the international level too. With regard to reducing GHG emissions to bring temperature at certain levels, countries must share burden equitably. Countries like India must give voice in this direction.

16.7 INDIA'S RESPONSE FRAMEWORK

India is one of the fastest-growing economies of the world with deficient energy sources to meet the growing economy. India has more than one billion population. Out of them, 800 million people (79.9 per cent of the population) live on less than the US \$ 2 per day. More than 700 million people cook on traditional cookstoves using crop waste and animal residue. More than 400 million people do not have access to electricity. India stands at 128th position in the World Human Development Index. Further, the rural population is more vulnerable to climate variability as they have low adaptive capacity concerning extreme and fluctuating weather condition. The IPCC assessment report reveals the following:

- Increase in rainfall over the Indian sub-continent by 6-8 per cent.
- Extreme rise of maximum and minimum temperature is expected in the West Coast of India and West Central India.
- Heat spell has become common in Northern India.
- There were around 15 significant droughts in the past 50 years, which affected the productivity of rain-fed crops in drought years.
- Food security is under threat due to the occurrence of drought and flood, and variability in the climate.

The adverse impact of climate change has already threatened the existing livelihood in India, for which India has undertaken various sectoral mitigation measures to contribute towards the objectives of United Nations Framework Convention on Climate Change (UNFCCC). India's development plan is based on the primary principle of sustainability, along with inclusive economic growth. There have been initiatives taken in sectors like coal and oil, renewable energy, hydropower, social energy, energy efficiency and conservation, transport, agriculture, power sector, and so on. The broad areas where the adaptation measures have been carried out include:

- Crop Improvement
- Drought Proofing
- Health
- Risk financing
- Disasters management
- Livelihood Preservation

16.8 NATIONAL ACTION PLAN ON CLIMATE CHANGE

National Action Plan for Climate Change (NAPCC) was formulated and released on 30th June, 2008. The guiding principles for NAPCC are given below:

- Formulation of inclusive, climate change policies by protecting the rights of the poor and vulnerable;
- Achieving national growth objectives by taking measures in a definite direction that must address ecological sustainability which further address greenhouse gas mitigation;
- Devising efficient and cost-effective strategies for end use demand side management;
- Developing and deploying appropriate technologies for both adaptation and mitigation of greenhouse gases emission extensively at an accelerated pace;
- Encouraging all stakeholders to develop a new and innovative forms of market, regulatory and voluntary mechanisms to promote sustainable development;
- Ensuring effective implementation of programme through unique linkages, including with civil societies and local government institutions and through public-private partnership;
- Encouraging international cooperation for research, development, sharing and transfer of technologies enabled by additional funding and a global IPR regime that facilitates technology transfer to developing countries under UNFCCC.

Based on the above-mentioned guiding principles, the Government of India has developed eight National Missions.

- 1) National Solar Mission (NSM);
- 2) National Mission for Enhanced Energy Efficiency (NMEEE);
- 3) National Mission on Sustainable Habitat (MNSH);
- 4) National Water Mission (NWM);
- 5) National Mission for Sustaining the Himalayan Ecosystem (NMSHE);
- 6) National Mission for a Green India (GIM);
- 7) National Mission for Sustainable Agriculture (NMSA); and
- 8) National Mission on Strategic knowledge for Climate Change (NMSKCC).

These missions will be implemented through different ministries based on their subject matter. Apart from ministries assigned to the task, Ministry of Finance, Planning Commission, experts from industry, academics and civil society will be part of the mission. The institutional structure depends upon task allocated for particular mission. Each ministry implements the mission by formulating necessary policies and programmes and develop detailed mission document which will be placed in the individual ministry website. We will discuss mission goals, strengths and weaknesses.

National Solar Mission

Mission has ambitiously targeted to generate considerable percentage of solar power by each state in India individually and country as a whole. The Mission's Renewable Purchase Obligations (RPOs) and auction process has brought fair degree of transparency and accountability to the process. According to the reports, the mission could able to achieve a substantial amount of work in the Phase I. The Mission has failed to recognize the potential off-grid generation which might helpful for poor and vulnerable. India is implementing various sustainable development programmes from first five-year plan period onwards. The success of solar water heater scheme of Ministry of Non-Conventional and Renewable Energy in 1990s in the State of Karnataka and Maharashtra might be notable example for emulation.

- The National Solar Mission aims at generating 20,000 MW of solar power by 2022.
- The Mission also has other targets: 2000 MW of off-grid solar plants, and 20 million square meters of solar collectors to be installed. In addition, 20 million solar lighting systems will be created/distributed in rural areas, saving about 1 billion litres of Kerosene every year.

National Mission for Enhanced Energy Efficiency (NMEEE)

The mission has introduced innovative measures like Perform, Achieve and Trade (PAT), Super-Efficient Equipment Programme (SEEP), and Market Transformation for Energy Efficiency (MTEE). The mission has made available necessary funds to achieve targets like Partial Risk Guarantee Fund (PRGF) and Venture Capital Fund for Energy Efficiency (VCFEE). The mission target was not holistic rather it targets only sub-sectors. It concentrates only on large scale industries.

National Mission on Sustainable Habitat (MNSH)

Mission plan was integrated with already existing plan Jawaharlal Nehru Urban Renewal Mission and tried to bring smart cities with energy efficient components. Mission must integrate their ideas by using bottom-up approach to the planning and all its planning should be from stakeholders' perspective.

National Water Mission (NWM)

Mission affirms to bring comprehensive data base on the existing water sources. Study must be conducted on the relationship between water and climate change. Identifying existing water sources and restoring and rejuvenating with the help of communities are significant.

National Mission for Sustaining the Himalayan Ecosystem (NMSHE)

The mission aims to evolve policy and management strategies for protecting and sustaining the Himalayan Mountain ecosystem including Himalayan glaciers. Further, it aims to establish "an observational and monitoring

network” to assess the resources and ecosystem health of Himalayan ecosystem. The mission recognises the importance of the Himalayas in sustaining large number of people and serves as an opportunity to promote a mountain-driven rather than plains-driven approach. Poor and vulnerable people are directly affected by the deforestation, depletion of natural resources and the construction of dams.

National Mission for a Green India (GIM)

The overarching target of the GIM is to double the area to be taken up for afforestation/eco-restoration in India in the next 10 years, taking the total area to be afforested or eco-restored to 20 million ha. This would increase the above and below ground biomass in 10 million ha of forests/ecosystems, resulting in increased carbon sequestration of 43 million tons CO₂e annually. Mission has ambitious plan to regulate and institutionalize local community level institutions. Mission will identify best practices and same will be used as learning sites.

Key features of GIM include:

- Increasing the quality of our forest cover by increasing the cover and density of our medium density and degraded forests.
- Taking a holistic view of forestry, and not merely focus on plantations to meet carbon sequestration targets.
- Focusing on decentralization and involving existing local governance institutions. Forests are the main source of livelihood to over 200 million people in India and hence GIM will actively try to secure the participation of local communities.

National Mission for Sustainable Agriculture (NMSA)

Mission understood the problems faced by country especially agriculture sector with regard to climate change. But mission failed to understand the problems of marginal and small farmers. Identifying and scaling up of agriculture based on agro-climatic zone is important. The mission fails to address fuel and fertiliser shortages. In the era of post-globalization and mechanization of agriculture, the sector altogether faces different kinds of problem.

National Mission on Strategic Knowledge for Climate Change (NMSKCC)

It is significant to encourage all stakeholders to do research on long-term consequences of climate change. Knowledge gap and the impact of socio-economic changes must be identified through research.

Check Your Progress 2

Note: i) Use the space given below for your answers.

ii) Check your answers with those given at the end of the unit.

1) What is GIM? Explain its key features.

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2) What are the eight missions under National Action Plan on Climate Change (NAPCC)?

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16.9 STATE GOVERNMENTS' EFFORTS TO ADDRESS CLIMATE CHANGE: STATE ACTION PLAN

The central government formulated NAPCC and requested all State governments to formulate State Action plan on Climate change (SAPCC). In 2009, the Government of India notified state governments to come up with their own climate change policies related to mitigation and adaptation. The plans and actions should be aligned with their respective state priorities as well as the NAPCC goals. Hence, the State Action Plan on Climate Change (SAPCC) in India is the most notable policy reflecting the nature of decentralized climate change mitigation framework of the country.

The State governments need to take following steps before implementing “State Action Plan on Climate Change”. It required to seek prior approval from the Ministry of Environment, Forest and Climate Change (MoEFCC) before implementation of activities listed therein. For implementation of SAPCCs, a combined budgetary requirement of INR 11.32 lakh crores (USD 188.66 billion) has been received by the ministry (MoEFCC, 2014). Ministry will scrutinize the proposal and disburse the required amount as per needs of the State governments. However, States may receive all necessary help from the centre to implement their plans to achieve national targets and priorities related to climate change.

India has vast geographical area having varied agro-climatic conditions. It is important to formulate policies by considering all these factors. Central government broadly frame the policies and state and local governments make necessary changes in the same to suit their local conditions and implement the same within the decentralized framework of mitigation strategies. India as mentioned earlier is a federal State and always involves every level of governance structure for a critical policy intervention. Delivery of services and implementation will be effective only if all are involved in it. With regard to climate change policy, disaggregated climate data clearly indicates that the vulnerabilities and opportunities will be well understood at the state and local level than at the country level. Through states, national policies reach to a large number of sectors and actors effectively while addressing state priorities at the same time. In addition, measurement and monitoring at the state level can be taken up more efficiently. For this reason, many of the national policies in India are implemented through the states. Some other standalone programmes like renewable purchase obligations, implementation of feed-in-tariffs, setting up of state energy conservation funds, implementation of small and hybrid hydroelectric systems and energy conservation building codes are some of the examples of policies that are implemented through the states. Almost all of these now come together within the larger umbrella of the state action plans.

It is significant for the learners to remember the following points related to policies.

- The Ministry of Environment, Forest and Climate Change requested all Indian States to develop action plans by defining their activities and programmes to be undertaken with the aim of adaptation and mitigation in consonance with the objectives of NAPCC.
- The objectives of the NAPCC were to ensure sustainable development in the country. It will provide guidance to formulate necessary policies in a sustainable manner in future. This can be achieved only through the active support of State and local governments. Hence, the Government of India has encouraged the State Governments to develop State Action Plan on Climate Change (SAPCC).
- SAPCCs would address the need of the country as well as provide direction to achieve the same. It would help identify measures that promote our development objectives while also yielding co-benefits for addressing climate change effectively.
- It wants to advance India's development and climate change-related objectives of adaptation and mitigation.
- GIZ and other organizations such as the United Nations Development Programme (UNDP), UK Department for International development and The World Bank are providing technical assistance to the interested Indian States in the development of SAPCC.

- The State-level plans are not only important for implementation of the NAPCC, but also inclusion of particular regional and local characteristics and specific concerns of vulnerable sectors and communities within each State. Let's now see few examples.

16.9.1 Tamil Nadu

The State of Tamil Nadu in order to further their proactive measures against climate change; and in response to National Action Plan on Climate Change (NAPCC), established the Tamil Nadu State Climate Change Cell (TNSCCC). It has also established web portal to disseminate information. The cell has visualized for building the capacity of all the stakeholders to respond climate change with various measures. It has a vision to make the state resilient. It has planned to collect necessary data and analyse the same to disseminate scientific information among farmers', fishermen, general public, policy planners', decisions makers', bureaucrats' and others. The important scientific contribution to address climate change was the development of "ClimaRice". "ClimaRice" is indeed an "Intercontinental collaborative project" entitled "Climate Change and persistent Droughts: Impact, vulnerability and adaptation in rice growing sub-divisions in India". Through this project, climate change impacts on Cauvery Basin of Tamil Nadu, which is drought prone have been investigated both in the current and projected climate scenarios. Eventually, a series of adaptation measures have been developed with an aim of sustaining the production in the Cauvery Basin.

The strategies suggested as part of the project to address climate change in the Cauvery basin are:

- Creating awareness among farmers' and other stakeholders to do minimum tillage to retain soil carbon content;
- Strategies to develop and promote the "use of drought and flood tolerant varieties";
- Promoting the crop rotation practices that augment soil productivity;
- Short duration pulse crops are recommended as relay crop, which would enrich the soil with nitrogen, improve soil fertility, and reduce dependence on the chemical fertilizers and pesticides;
- Encouraging the use of quality inputs like quality seeds, and market intelligence;
- Encouraging the farmers to grow green manure crops, and use biofertilizers;
- Introduction of modified cultivation methods such as "System of Rice Intensification"; and
- Promotion of crop residue retention on soil to build up soil biomass.

The broad strategies for climate change adaptation in agriculture and horticulture sector in Tamil Nadu are given in the box 16.1.

Box 16.1: Broad strategies for climate change adaptation in agriculture and horticulture sectors in Tamil Nadu

- Sowing is recommended to be in consonance with the onset of South-west and North- east monsoons;
- Soil erosion must be managed through measures such as minimum tillage, mulching, etc.;
- Soil health and soil nutrient content may be improved through soil-test based Integrated Nutrient Management;
- Promotion of Integrated Pest and Disease Management;
- Water-use efficiency can be improved through methods such as drip, sprinkler irrigation, etc.;
- System of Rice Intensification (SRI) can double or triple current rice yields;
- Emphasis must be on to develop and introduce new crop varieties that are tolerant to high temperature and water stress;
- “Crop Diversification” is recommended to augment the livelihoods;
- Integrated Farming System is recommended to utilize the farm resources efficiently.
- Risk Mitigation Measures such as compulsory crop insurance are recommended to compensate for the crop losses due to extreme weather events;
- Supply of quality agricultural inputs;
- Capacity building on latest agricultural technologies;
- “Rain water management practices at household and landscape level”;
- “Institute a long-term rice varietal development program to make available new rice varieties and conserving local gene pool through public-private partnership, and actively engaging local farmers, women, and other local agencies in the process”.
- “Help farmers adopt tailored farming practices including soil nutrient management, choice of crop and cultivars, and pests and disease management as per the suitability/potential of different agro-climatic zones based on weather-based advisories derived from climate analysis of the local area and forecasting which includes probable occurrence of pests and disease”.

- “Support research on weather-based crop insurance schemes to cover risks of increasing intensities and frequencies of extreme weather events. The challenge is to develop a weather-based index to simplify the insurance claims and payment procedures”.

Reference: <http://www.environment.tn.gov.in/doc/TNSAPCC%20PDF/Chapter%205%20Sustainable%20Agriculture%20.pdf> ; Government of Tamil Nadu. 2013. State Action Plan on Climate Change. Chennai: Government of Tamil Nadu.

16.9.2 Delhi

Cities in India are expected to grow with approximately additional 500 million populations. In this transition, governments at all levels especially city government need to equip themselves to address the needs of population in the areas of physical infrastructure, social infrastructure, housing, water, public transportation, health, education, sewage system and solid waste management. Cities, especially mega cities in India with high concentration of population are at risk from the impact of climate and related issues.

Delhi, the capital of India, with geographical area of 1483 square km with high air pollution has developed specific agenda to address and combat climate change. Delhi face threat from climate change and related issues on infrastructure, human lives, human health, personal property, environmental quality and future prosperity. Delhi has introduced a Delhi Climate Change Agenda (2009–2012) by incorporating actions to address the issues raised in the Prime Minister’s National Action Plan on Climate Change. Delhi Government’s agenda aims to reduce Delhi’s carbon footprint by identifying 65 set of action points. These actions will be addressed by taking appropriate measures at the policy level by the various departments of Delhi government. For example, the government of Delhi introduced compressed natural gas (CNG) fuelled buses for public transport by replacing existing diesel fuelled buses. Delhi government with the help of central government implemented Jawaharlal Nehru Urban Renewal Mission (JNURM) in 2005 itself to address issues related to urban development. But these schemes should be integrated with climate adaptation, mitigation and climate change related risk management.

Delhi cabinet has decided to upgrade energy efficiency of existing government buildings through retrofitting which are to be carried out by energy service companies in a performance contracting mode. The objective is to ensure that the government buildings can achieve at least rating of one star from BEE under their office building labelling programme. Delhi government is also considering the installation of energy efficient water and wastewater treatment operations and methane recovery and reuse for a CDM project.

16.9.3 JHARKHAND

Jharkhand has area coverage of 79,714 square km. Jharkhand has 24 administrative districts. Ranchi is the state capital as well as an industrial city. It has rich physiographic characteristics. The rivers Swarnrekha, Koyal, Shankh and Damodar flow through the State and are utilized for irrigation in many places in the State. Jharkhand has around 40 per cent of the country's mineral resources such as coal, iron ore, copper, uranium, mica, bauxite, granite, limestone, silver, graphite, magnetite and dolomite. It possesses about 40 per cent of the country's mineral wealth. 11 per cent to the State's GSDP comes from mining and quarrying activities. The State mineral reserves include coal, iron ore, bauxite, copper, mica, graphite, manganese, lead, silver, uranium and limestone. The State exports minerals to Bangladesh, Nepal, South Africa and Saudi Arabia. As regards the measures with respect to climate change mitigation, the state has proposed a scheme called Jharkhand Solar Policy (2015).

Jharkhand Solar Policy 2015

The objective of the scheme is to encourage participation of private sector to set up solar power-based projects in the State and increase solar power generation to 2500 MW by the year 2020 in a phased manner.

The Jharkhand Renewable Energy Development Agency (JREDA) was incorporated as a society in the year 2001 for promoting use of renewable energy sources in the state. Being a nodal agency, JREDA is working for implementation of fiscal and financial incentives made available by the Ministry of New and Renewable Energy Sources (MNRES), Govt. of India and Indian Renewable Energy Development Agency (IREDA).

16.10 ASSESSMENT OF STATE ACTION PLANS ON CLIMATE CHANGE

This section broadly assesses the existing State Action Plans to address climate change. India has to prepare detailed nation-wide project for 15 agro-climatic zones with varying vulnerabilities. By considering the vastness and varying agro-climatic zones, central government made all States to participate actively to address climate change by assessing their own vulnerabilities. It needs to prepare detailed plan document on par with NAPCC. It needs to identify projects and prepare budgeting and monitoring mechanisms. State governments have freedom to involve local self-governments to implement projects related to climate change. This exercise was considered as one of the biggest in the world. The State Action Committees submitted 32 plan proposals to the Union Ministry of Environment, Forest and Climate Change (MoEF&CC). The Common framework document for SAPCCs circulated by MoEF&CC requires States to assess "the physical and economic impact of and vulnerability to climate change on the most vulnerable sectors and vulnerable groups". This is very

important to plan, adopt and implement mitigation strategies. For example, States like Tamil Nadu, Gujarat, Maharashtra, Karnataka, Orissa, West Bengal and Andhra Pradesh have long coast lines. These States are vulnerable to frequent cyclone and flood. Fishermen and cities close to coastal areas get affected by the unexpected monsoons. It is necessary for these states to assess vulnerability of fishermen and others who are directly depended on sea for their livelihoods. The analysis of Centre for Science and Environment (CSE) shows that “the SAPCCs submitted by most states lack detailed vulnerability assessments. Some are so broad and general that they risk overlooking specific local issues, while others like Gujarat, Odisha and Tamil Nadu have assessed their vulnerability based on a few projects. SAPCCs of Mizoram and Uttarakhand do not even mention vulnerability assessment”. According to the report prepared by CSE, the Uttarakhand State has conducted several consultations among civil society groups and academics to recognize the severity of climate vulnerabilities. The result of the consultation was missing in the report. Punjab conducted stakeholder consultation for preparing its SAPCC. Mizoram neither held consultations with civil society nor vulnerable communities. Some have adopted international and national level models and used the same to assess and prepare vulnerabilities. But these models have their own limitations with respect to projects, region or State specific changes and vulnerabilities. India’s climate system is monsoon driven. States must plan adaptation and mitigation strategies according to climate change projection scenarios. According to CSE analysis, “Mizoram and Odisha lack climate projections in their SAPCCs, while others, including Gujarat, rely on climate models used by the UK. Madhya Pradesh made mid-century and end-century projections based on secondary data collected from various sources. CSE researchers found that the states are depending on secondary sources due to lack of domestic climate models. The outcomes of such projections based on flawed models have a degree of uncertainty as climate change impact is highly local in nature” (Down to Earth, 2018).

The next comes finance. The States have no clarity about financing. It has assumption that the central government or international organization would provide required finance to implement their projects. States like Madhya Pradesh demanded Rupees 4,700 crores, while Tamil Nadu demanded more than Rupees 400,000 crores. Gujarat allocated around 80 per cent to the water sector. Most states do not depict the true picture of their vulnerability in the SAPCC document and the required steps that need to be taken to enhance their adaptive capacity and reduce their vulnerability to climate change extremes. The documents lack mentioning the effective monitoring and evaluation institutions for the project implemented to address climate change. States such as Kerala and Uttarakhand, are in the process of revising their SAPCCs to meet their domestic and international objectives after recognising the inadequacy in the existing document. “The state of Mizoram has initiated a ninth mission on health, in addition to the eight national-level missions for

climate change. The state government is of the opinion that health is one of the major climate change impacts and hence has included it as an additional mission. The National Adaptation Fund for Climate Change (NAFCC) is funding a project to augment livelihood of rural communities by building resilience in agriculture. The project is being implemented by the state agriculture department and is currently in its third year” (Down to Earth, 2018).

Check Your Progress 3

Note: i) Use the space given below for your answers.

ii) Check your answers with those given at the end of the unit.

- 1) Write short note on the policies of the State of Tamil Nadu to mitigate climate change.

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- 2) What is State Action Plan on Climate Change?

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16.11 LET US SUM UP

The climate change is the biggest threat in the 21st century. The international scientific community urged the world to stabilize the level of emissions in the atmosphere in order to avoid future potential impact. In doing so, the countries have proposed several international summits to discuss climate change and to find solution to the problems of climate change. This process is started in the year 1988 in Toronto as a World Conference on Changing Atmosphere. The conference recommends reducing carbon dioxide emission by 20 %. In the same year Intergovernmental Panel on Climate Change (IPCC) met in Geneva and assessed the state of scientific knowledge on climate change, evaluated its impact and brought realistic solution. The first IPCC report was published in the year 1990. All these events led to the world community to conduct series of climate conferences. Further, we have studied about Kyoto Protocol and Paris Agreement on Climate Change.

Through this unit, we have discussed that India has taken a firm and reasonable stand towards climate change negotiations. The State Action Plan on Climate Change (SAPCC) and its impact too discussed in the unit.

16.12 KEY WORDS

International Organization: Organization which presents at international level with scope of dealing issues among nations.

Niti Aayog: It is a premier think tank of Government of India to provide critical knowledge for policy formulation.

16.13 SUGGESTED FURTHER READING/REFERENCES

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16.14 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

1) The key issues discussed at Copenhagen summit are as follows:

- Continuing negotiations of Kyoto protocol.
- Making governments to commit midterm GHG emissions reduction.
- Developing, monitoring, reporting and verification methods.
- Funding for adaptation and mitigation.
- Transferring technology to the developing countries.

2) India's expectation from Copenhagen summit

- International cooperation should be there to combat climate change.
- The outcome of the negotiations in the Copenhagen should be fair and equitable. It must be in accordance with the principle of common but differentiated responsibilities and respective capabilities as per 1992 Rio declaration.
- Summit should provide a space to accelerate socio-economic development in order to eradicate poverty through ecologically sustainable manner.

Check Your Progress 2

1) GIM means Green India Mission. Key features of GIM include:

- Increasing the quality of our forest cover by increasing the cover and density of our medium density and degraded forests.
- Taking a holistic view of forestry, and not merely focus on plantations to meet carbon sequestration targets.
- Focusing on decentralization and involving existing local governance institutions. Forests are the main source of livelihood to over 200 million people in India and hence GIM will actively try to secure the participation of local communities.

2) The eight National Missions under National Action Plan on Climate Change are as follows:

- National Solar Mission (NSM);
- National Mission for Enhanced Energy Efficiency (NMEEE);
- National Mission on Sustainable Habitat (MNSH);
- National Water Mission (NWM);
- National Mission for Sustaining the Himalayan Ecosystem (NMSHE);
- National Mission for a Green India (GIM);
- National Mission for Sustainable Agriculture (NMSA); and
- National mission on Strategic Knowledge for Climate Change (NMSKCC).

Check Your Progress 3

1) The State of Tamil Nadu in order to further their proactive measures against climate change; and in response to National Action Plan on Climate Change (NAPCC), established the Tamil Nadu State Climate Change Cell (TNSCCC). It has also established web portal to disseminate information. The cell has visualized for building the capacity of all the stakeholders to respond climate change with various measures. It has planned to collect necessary data and analyse the same to disseminate scientific information among farmers', fishermen, general

public, policy planners', decisions makers', bureaucrats' and others. The important scientific contribution to address climate change was the development of "ClimaRice". "ClimaRice" is indeed an "Intercontinental collaborative project" entitled "Climate Change and persistent Droughts: Impact, vulnerability and adaptation in rice growing sub-divisions in India". Through this project, climate change impacts on Cauvery Basin of Tamil Nadu, which is drought prone have been investigated both in the current and projected climate scenarios. A series of adaptation measures have been developed with an aim of sustaining the production in the Cauvery Basin.

- 2) Government of India formulated NAPCC and requested all State governments to formulate State Action plan on Climate change (SAPCC). In 2009, the Government of India notified state governments to come up with their own climate change policies related to mitigation and adaptation. The plans and actions should be aligned with their respective state priorities as well as the NAPCC goals. The State Action Plan on Climate Change (SAPCC) in India is the most notable policy reflecting the nature of decentralized climate change mitigation framework of the country. SAPCCs would address the need of the country as well as provide direction to achieve the climate change mitigation and adaptation.