



**BLOCK 3**

**HEALTH, EDUCATION AND FOOD SECURITY**

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## **UNIT 8    RELATIONSHIP BETWEEN SUSTAINABLE DEVELOPMENT AND FOOD SECURITY\***

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### **Structure**

- 8.0 Objectives
- 8.1 Introduction
- 8.2 Concept and Evolution of Sustainable Development
- 8.3 Meaning and Concept of Food Security
- 8.4 Dimensions of Food Security
- 8.5 Relationship between Sustainable Development and Food Security
- 8.6 Conclusion
- 8.7 Glossary
- 8.8 References
- 8.9 Answers to Check Your Progress Exercises

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### **8.0    OBJECTIVES**

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After reading this Unit, you should be able to:

- Explain the concept and evolution of sustainable development;
- Discuss the meaning of food security;
- Describe the dimensions of food security; and
- Examine the relationship between sustainable development and food security.

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### **8.1    INTRODUCTION**

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Sustainable development, by now we know, is a process of integrating economic, social, and environmental objectives. For a healthy and productive life, everyone should have sufficient access to nutritious and affordable food. The relationship between sustainable development and food security is highly complex and has assumed greater significance in the present times. The very notion of sustainability in food production systems including agriculture, livestock and fisheries is intrinsically linked to the idea of adequate food accessible for both present and future generations. To ensure long-term food security, application of the principles and core values of sustainable development in food production systems is important. Similarly, the way and manner in which agriculture is being practiced, including land and water use, has immense impact on ecological sustainability.

Sustainable development, you must have gathered by now, is a new developmental paradigm. It redefines human and environmental interactions in the 21st century. It is a kind of developmental process that enables the present generations to meet their needs, without compromising the ability of future generations to meet their own needs including food. One of the essential needs of people is the need for

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food, and is being considered as a basic human right. Food apart from providing sustenance to people is also used in various human expressions of culture, social systems and religious beliefs.

Food security is defined as a situation in which all people, at all times, have physical, social and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life. Although, at the global level, there has been a significant progress in increasing the average food consumption over the last 30 years, there are some 840 million people still, who are chronically undernourished, mainly in the developing countries due to various reasons, including the problems related to sustainability of food production systems.

The steady and unprecedented increase in human population in developing countries has caused food shortages, and put stress on the available natural resources. Impoverishing the natural potential of the ecosystems reduces agricultural yields, which affects the food security of the people living in these areas. The shortage of cropland is a significant factor contributing to global food shortages and associated human malnutrition and hunger. For example, in Africa, there has already been a decline in agricultural output and thus, there is a threat to food security. Increasing world food production without compromising the ecological sustainability is a huge challenge. This Unit will discuss the meaning and dimensions of food security and bring out the interconnection between sustainable development and food security. Though the earlier Units of this Course have already brought out the concept of sustainable development quite clearly, this Unit revisits it in order to make the issue at hand more comprehensible.

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## 8.2 CONCEPT AND EVOLUTION OF SUSTAINABLE DEVELOPMENT

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### *Concept of Sustainable Development*

Sustainable development is a process of integrating economic, social and environmental objectives of development. The most popular definition of the term of sustainable development was coined by the United Nations Commission on Environment and Development in 1987. The Report of the Commission, *Our Common Future*, as we have read in almost all Units of this course, has defined sustainable development as development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs.

This is the most frequently cited definition of sustainable development. It puts emphasis on two intrinsic ideas:

- **Concept of ‘needs’**, in particular, the essential needs of the world’s poor; and
- **Idea of limitations** imposed by the state of technology and social organisation on the environment’s ability to meet the present and future needs.

These ideas are the moral imperatives in fulfilling the urgent development needs of the world’s poor living in developing countries and the threat to continued progress as a result of the failure to respect environmental limits. Also, this popular

definition of sustainable development proposes *three* new principles in the form of core elements:

- **Mutuality:** Sustainable development recognises that human beings affect the environment and are in turn affected by it;
- **Sustainability:** Sustainable development acknowledges that human interactions with the environment must be sustainable in the long -run; and
- **Integration:** Sustainable development implicitly accepts the interconnections among environment, social development and economic development.

### ***Evolution of Sustainable Development***

Since the 1990s, the concept of sustainable development has increasingly been endorsed by governments and agencies of United Nations. It has gradually emerged as a new international norm qualifying the kind of change that is to be regarded as authentic development. The concept of sustainable development, as you have read in earlier Units, evolved in its current form through *four* main events. Let us now see what kind of events these were:

#### **i) United Nations Conference on the Human Environment (1972)**

The United Nations Conference on the Human Environment held at Stockholm in 1972 popularly known as Stockholm Conference became a key symbol of political acknowledgement of the growing worldwide awareness on the need and importance of protecting the environment.

#### **ii) World Commission on Environment and Development (1983)**

World Commission on Environment and Development released its Report 'Our Common Future' which was also called the Brundtland Report in 1987 before it officially dissolved itself. The Report aimed to explore the conditions of the world's natural systems and provide an outlook for global environmental health.

#### **iii) United Nations Conference on Environment and Development (1992)**

The UN Conference on Environment and Development (UNCED), also known as the Earth Summit, renewed the world's interest in sustainable development in 1992. This Summit was seen as a milestone in global environmental governance.

#### **iv) World Summit on Sustainable Development (2002)**

The World Summit on Sustainable Development is the most recent event to highlight the importance of practical implementation of sustainable development. The Summit specified a number of commitments of the nations for implementing the principles of sustainable development and outlined the priority areas.

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## **8.3 MEANING AND CONCEPT OF FOOD SECURITY**

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Now that we are clear about the concept of sustainable development, let us try to understand another term related to sustainable development, that is food security.

The concept of food security is an unobservable variable with complex multi-factored consequences. It has been used in nearly 200 different ways in numerous academic and policy discourses and it has 450 indicators. The definition of food security has evolved over a period of time. In 1974, food security was defined by the World Food Summit (WFS) as the “availability at all times of adequate world food supplies of basic food stuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices.” This was expanded by the Food and Agriculture Organisation (FAO) in 1983 to include access of vulnerable people to available supplies.

By the mid-1990s, food security had become a major concern at a global level, and access to food now included sufficient food, indicating concerns for protein-energy malnutrition. Later, this definition was further expanded to incorporate food safety, nutritional balance, and food preferences. In 1994, the United Nations Development Programme (UNDP) in its *Human Development Report* included food security within the concept of human security.

This reflected in the new definition of WFS (1996), which redefined food security as a situation that ‘exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life’. In 2001, this definition of food security was also modified a little by inserting the word 'social', as “a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life”.

Today, the meaning and core concept of food security has significantly changed from focusing on the availability and stability of basic food supply at the national and international levels to accessibility of food supply at the individual household levels. Food security is not narrowly defined as whether food is available, but whether the monetary and non-monetary resources are available at the disposal of the population to access adequate quantity and quality of food.

### ***Food Insecurity***

Food insecurity is the involuntary shortage of food due to economic constraints. When this food shortage progresses to the point that physical symptoms are felt, hunger occurs. The conceptual understanding of food insecurity has gradually evolved over the years to include not only transitory problems of inadequate food supply at the national level, but also chronic problems of insufficient access and unequal distribution at the individual and household levels. There are many types of food insecurity:

- **Chronic Food Insecurity**

This is usually a long-term phenomenon. This occurs when people are unable to meet their minimum food requirements over a sustained period of time. Low incomes and continuing poverty are mainly responsible for it.

- **Transitory Food Insecurity**

This is a short-term and temporary condition of food shortage. This happens due to sudden drop in production or lack of access to enough food due to natural disasters, conflict or economic collapse.

- **Seasonal Food Insecurity**

Seasonal food insecurity is just like chronic food insecurity. It has limited duration and can be seen as recurrent transitory food insecurity. It is relatively easier to predict because it follows a sequence of known events. It occurs due to seasonal fluctuations in weather, climate, cropping patterns, and diseases at certain times.

### 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. Discuss the concept of sustainable development.

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2. Explain the concepts of ‘food security’ and ‘food insecurity’.

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## 8.4 DIMENSIONS OF FOOD SECURITY

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Food security has *four* key dimensions: availability, stability, access, and utilisation. These dimensions reflect the physical and economic access to food that meets people’s dietary needs and preferences:

- ***Food Production and Availability (is enough food produced)***

Food production is related to the ability of food production system to produce sufficient quantity of food for people. This dimension addresses the supply side of the food security and expects sufficient quantities of quality food. Production of food is highly dependent on rainfall characteristics, combined with other factors including government policies related to provisions of agricultural inputs, pricing mechanism and ability to access the market. Food availability means that there is enough quantity of food available at all times. Food availability addresses the “supply side” of food security and is determined by the levels of food production, stocks and net trade.

- ***Access to Food (can people get it and afford it)***

An adequate supply of food at the national or international levels does not in itself guarantee household level food security. Food access is another

dimension of food security, which encompasses income, expenditure and buying capacity of households or individuals. Food access is related to the availability of required resources with people to obtain the amount of food needed for a nutritious diet. Food access addresses whether the households or individuals have enough resources to acquire appropriate quantity of quality food. It is also related to a situation, whereby food is allocated through markets and non-market distribution mechanisms. Access to food mostly depends on not only the physical criteria like infrastructure, but also the financial factors.

- ***Food Utilisation(how do local conditions bear on people's nutritional uptake from food)***

Food utilisation is commonly understood as the way the body makes the most of various nutrients in the food. In other words, it is the appropriate use of a variety of food items based on the knowledge of basic nutrition and care. Combined with good biological utilisation of food consumed, food utilisation determines the nutritional status of individuals. It addresses not only how much food the people eat but also what and how they eat. In fact, sufficient energy and nutrient intake by individuals is the result of good care and feeding practices, food preparation, diversity of the diet, intra-household distribution of food, water, sanitation and health care practices.

- ***Stability of Food Supplies(is the supply of food and its access ensured)***

Adverse weather conditions, political instability, or economic factors (unemployment, rising food prices) may have an impact on food security status of individuals. This dimension of food security addresses the stability of the other three dimensions over time. Stability of food supplies could be affected by changes in food availability and access to food. People cannot be considered food secured until they feel so and until there is stability of availability, accessibility and proper utilisation of food condition. In addition, stability of crop yields and food supplies is negatively affected by variable weather conditions.

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## **8.5 RELATIONSHIP BETWEEN SUSTAINABLE DEVELOPMENT AND FOOD SECURITY**

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The unprecedented increase in population during the last half-century led to increasing food demand. The productive capacity of cultivated systems has stagnated or even declined in the face of increased food demand from growing populations. The shortage of cropland, together with falling productivity, is a significant factor contributing to global food shortages and associated human malnutrition and hunger across the world. To meet growing demands, massive transformation of natural ecosystems is needed. The single greatest land use by humans has occurred for the singular purpose of obtaining more accessible, reliable, and productive sources of food.

Food production systems face global challenges. These include meeting the growing demand for food, reducing poverty and malnutrition, and achieving environmental sustainability. The high prevalence of starvation, hunger, and malnutrition across the world, particularly in developing countries is related to



sustainability of global agriculture production. Today, the world has around 852 million chronically hungry people. Feeding this growing population and reducing the prevalence of hunger adequately will only be possible if agricultural yields can be increased significantly. However, the demand for food has long since outstripped the capacity of nature to provide it. Therefore, the adoption of sustainable development approach is important to ensure long-term food security. The complex relationships between food security and sustainable development are influenced by the following issues:

### ***Green Revolution***

Low productivity in the agricultural sector has a huge impact that extends beyond the agricultural sector to food security and improved nutrition of children. Low productivity prevents households and countries from accumulating assets, diversifying their economies and making use of new technologies to move into higher value-added sectors. Low agricultural productivity is one of the most important factors that contribute to food insecurity in Sub-Saharan Africa.

To meet the growing demand for food, in the early 1960s, green revolution was introduced through the rapid transfer and adoption of new technologies in the agricultural sector. This included the use of chemical fertilizer and pesticides, irrigation technology, mechanisation of farms and new high-yielding seeds. The green revolution, a kind of shift from traditional to more modern agricultural methods, substantially reduced the risks of mass starvation and famines in the developing world.

Globally, the green revolution, while increasing agriculture productivity at an unprecedented scale, proved to be ecologically unsustainable since it has disturbed the environmental sustainability and ecological balance. It has also led to loss of biodiversity and associated traditional knowledge. However, over the years, the environmental and social problems associated with high levels of inputs, monoculture systems, inefficient and polluting use of water, and the inability to reach many small farmers have come to the fore.

### ***Loss of Biodiversity***

For centuries, the agricultural base of developing countries were built upon the locally available natural resources, indigenous knowledge and traditional methods of agriculture production. Traditional knowledge of resource conserving farming practices aimed at producing and harvesting different crop varieties, livestock and fisheries. Basically, these practices are in harmony with the environment.

However, over the years, a number of essential nutrients of the land have depleted due to large-scale introduction of single crop under mechanised agriculture practice. As a result of shifting the agriculture practices from genetically diverse traditional food crops to high-yielding monocultures has resulted in the loss of nearly three-fourth of its food crop diversity. The practice of chemical intensive farming, as part of green revolution has led to problems of water pollution in streams and rivers from the run off from fertilizers.

### ***Depletion of Livestock and Fisheries***

Livestock production has important implications for ecosystems and ecosystem services, as it is the single largest user of land either directly through grazing or

indirectly through consumption of fodder and feed grains. The global importance of livestock and their products is increasing as consumer demand expands with population growth, rising incomes, and urbanisation. This rapid worldwide growth in demand for food of animal origin, with its accompanying effects on human health, livelihoods, and environment brings the issue of sustainable development to the forefront.

Industrial livestock production, the most rapidly growing means of raising livestock, poses a range of pollution and human health problems. Intensive livestock feeding systems has given rise to serious food safety and health concerns. Some marine fish stocks are already under threat of extinction due to over-fishing. For example, modern forms of pig and dairy farming also produced serious problems of water pollution. The rapid expansion and increased technological efficiency in fisheries, as well as the global state of the resources is causing widespread concern.

### *Desertification*

Desertification is one of the greatest environmental and development problems of the 21st century. Desertification, as detrimental process brings about a gradual and an unnoticed reduction in the productive capacity of land over a period of years. The end point of this deteriorating and ecologically unsustainable process would lead to the formation of a complete wasteland incapable of producing anything useful for the community.

Many low income countries are located in tropical and sub-tropical regions, which are particularly vulnerable to rising temperatures, and in semi-desert zones, which are threatened by decreasing water availability. Large-scale droughts that affect several countries simultaneously have wider implications for food security.

Africa is highly susceptible to land degradation and it is estimated that two-thirds of African land is already degraded to some degree. Currently, land degradation affects 65 per cent of the people in Africa. Sub-Saharan Africa will have not just the highest incidence of hunger and poverty, as before, but also more food-insecure people than any other part of the world, including the developing countries of South Asia.

For example, per capita agricultural production increased by about 40 per cent between 1980 and 2001 in developing countries, but fell by about 5 per cent in Sub-Saharan Africa over the same period, in large part due to land degradation and low access to modern agricultural inputs and technology. Most of the population in African countries is experiencing high-drought frequency since they are agro-pastoralists, whose livelihoods are constantly threatened by erratic rainfall and arid environmental conditions. These countries are among the poorest in the world and are extremely vulnerable to natural disasters and are struggling to cope with the impacts of droughts and famines.

### *Climate Change*

Climate change has been identified as a 'threat multiplier' in global security, as it poses a threat to human security, particularly in societies that already lack significant progress in developmental sectors. Climate change worsens the living conditions of farmers, fishermen and forest-dependent people who are already

vulnerable and food insecure. More frequent and intense, extreme weather will have adverse immediate impacts on food production, infrastructure for food distribution, livelihood assets and opportunities in both rural and urban areas. Loss of arable land is likely due to increased aridity, groundwater depletion and rise in sea levels, which will have significant impact on global food security.

Among various regions, Africa is considered the most vulnerable region in terms of climate change, because of its physical and socio-economic characteristics and its extreme climatic conditions. African eco-systems are very fragile and cannot absorb the shocks that climate change introduces. Agricultural production in many African countries and regions is projected to be severely compromised by climate change. Increased climate variability and droughts in Africa may lead to significant loss of livestock. Nearly 40 per cent of the Sub-Saharan population is currently undernourished and this number is expected to increase.

As a multi-dimensional phenomenon, food security reflects the highly interconnected concerns of food access, availability, and utilisation, as well as the dynamic dimensions of ecological sustainability. Globally, the changed patterns of rainfall would have serious impact on food security. For example, climate change will have an overall negative effect on the yields of major cereal crops.

**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 different dimensions of food security.  
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2. Examine the relationship between sustainable development and food security.  
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## 8.6 CONCLUSION

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The concept of sustainable development derives from the fundamental concern of human society and its need for security. Sustainable development refers to a process of societal advance embodying a more equitable and environmentally aware pattern of development that requires a careful integration of economic, social, and environmental objectives. Food is one of the essential needs of people

and a basic human right. Food security means access of the people to a reliable supply of food from socially acceptable sources sufficient for an active and healthy life. The very notion of sustainability in food production system is intrinsically linked to the idea of adequate food accessible for both present and future generations.

Adequately feeding this growing population and reducing the prevalence of hunger will only be possible if agricultural yields can be increased significantly. However, the demand for food has for long outstripped the capacity of nature to provide it. Therefore, the adoption of the sustainable development approach is important to ensure long-term food security. The complex relationships between food security and sustainable development are influenced by various issues.

Globally, the green revolution, while increasing productivity at an unprecedented level, has proved to be ecologically unsustainable since it has disturbed the environmental sustainability and ecological balance. Livestock production has important implications for ecosystems and ecosystem services, as it is the single largest user of land, either directly through grazing or indirectly through consumption of fodder and feed grains. As a result of shifting the agriculture practices from genetically diverse traditional food crops to high-yielding monocultures has resulted in the loss of nearly three-fourth of the food crop diversity.

Desertification, as detrimental process brings about a gradual and an unnoticed reduction in the productive capacity of land over time. The end point of this deteriorating and ecologically unsustainable process would be the formation of a large wasteland incapable of producing anything useful for the community. We can say that food security reflects the highly interacting concerns of food access, availability, and utilization, which are the dynamic dimensions of ecological sustainability. Agricultural production in many African countries and regions is projected to be severely compromised by climate change. This Unit discussed the intricate and pertinent interconnection between sustainable development and food security.

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## 8.7 GLOSSARY

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**Agropastoralists:** People whose source of livelihood come from a mixture of agriculture and livestock herding.

**Climate Change:** A global phenomenon of climate transformation characterised by the changes in the usual climate of the planet related to temperature, precipitation, and wind that are especially caused by human activities.

**Drought:** A reduction in precipitation over an extended period, which creates a water shortage that damages crops, livestock and environment.

**Famine:** The extreme scarcity of food, to such a degree, as to result in widespread starvation, affecting entire segments of the impoverished masses. Famine results from the immediate consequences of the lack of sustenance on a population. Famines usually last for a limited time, ranging from a few months to a few years. They cannot continue indefinitely, if for no other reason than that the affected population would eventually be decimated.

**Food Insecurity:**The involuntary shortage of food due to economic constraints.

**Food Security:** Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.

**Hunger:**Food shortage progresses to the point that physical symptoms are felt. Hunger is a persistent, chronic, long-term, and slowly debilitating problem associated with insufficient food. Hunger is more widespread and problematic than famine, yet it receives considerably less public attention.

**Malnutrition:**Physiological condition that can arise from both shortages of food and diseases. Malnutrition may range from mild to severe and could also be life-threatening. It can be a result of starvation, in which a person has an inadequate intake of calories, or it may be related to a deficiency of one particular nutrient.

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## 8.9 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

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### Check Your Progress 1

#### 1. Your answer should include the following points:

- A kind of developmental process that enables the present generations to meet their needs without compromising the ability of future generations to meet their own needs, including food.
- Sustainable development is a process of integrating economic, social and environmental objectives.
- Sustainable development emphasises two intrinsic ideas:
  - i) Concept of ‘needs’, in particular the essential needs of the world’s poor; and
  - ii) Idea of limitations imposed by the state of technology and social organisation on the environment’s ability to meet present and future needs.

#### 2. Your answer should include the following points:

- Evolution of food security as a concept over time.
- Definition given by World Food Summit (WFS) in 1974.
- Expanding the meaning by Food and Agriculture Organisation (FAO) in 1983.

- New definition given by the United Nations Development Programme (UNDP).
- Another expansion by World Food Summit (WFS) in 1996.
- A situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.

## Check Your Progress 2

### 1. Your answer should include the following points:

Food security has four key dimensions: availability, stability, access, and utilisation:

- Food production and availability (*is enough food produced*).
- Access to food (*can people get it, and afford it*).
- Food utilisation (*how do local conditions bear on people's nutritional uptake from food*).
- Stability of food supplies (*is the supply and access ensured*).

### 2. Your answer should include the following points

- The demand for food has for long outstripped the capacity of nature to provide it.
- The adoption of the sustainable development approach is important to ensure long-term food security.
- The complex relationships between food security and sustainable development are influenced by green revolution, loss of biodiversity, depletion of livestock and fisheries, desertification, and climate change.
- As a multi-dimensional phenomenon, food security reflects the highly interacting concerns of food access, availability, utilisation and the dynamic dimensions of ecological sustainability.
- Globally, the green revolution, while increasing agriculture productivity at an unprecedented scale, has proved to be ecologically unsustainable since it has disturbed the environmental sustainability and ecological balance. This has affected food security.
- As a result of shifting the agriculture practices from genetically diverse traditional food crops to high-yielding monocultures, nearly three-fourth of the food crop diversity has been lost.
- Intensive livestock feeding systems have given rise to serious food safety and health concerns.
- Desertification brings about a gradual and an unnoticed reduction in the productive capacity of land over a period of years.
- More frequent and intense, extreme weather will have adverse immediate impacts on food production, food distribution infrastructure, livelihood assets and opportunities in both rural and urban areas.

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## **UNIT 9    ROLE OF GREEN AND CONVERGING TECHNOLOGIES IN HEALTH, SANITATION AND FOOD SECURITY\***

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### **Structure**

- 9.0 Objectives
- 9.1 Introduction
- 9.2 Meaning of Green and Converging Technologies
- 9.3 Characteristics and Categories of Green Technologies
  - 9.3.1 Characteristics of Green Technologies
  - 9.3.2 Categories of Green Technologies
- 9.4 Role of Green Technologies in Health and Sanitation
- 9.5 Green Technologies and Food Security
- 9.6 Conclusion
- 9.7 Glossary
- 9.8 References
- 9.9 Answers to Check Your Progress Exercises

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### **9.0    OBJECTIVES**

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After reading this Unit, you should be able to:

- Explain the meaning of green and converging technologies;
- Describe the important characteristics and categories of green technologies; and
- Examine the role of green technologies in health, sanitation and food security.

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### **9.1    INTRODUCTION**

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Humanity's unprecedented demand for natural resources has rapidly increased in the last few decades. Not all natural resources are renewable, some of them are already depleted or ruined. Since the turn of the century, we are witnessing an increased level of awareness of the impact of humankind's modern lifestyle on environment. While the nations have made enormous progress in improving the material welfare of people over the past few decades, these spectacular achievements have come at the lasting cost of increasing level of environmental degradation and unprecedented nature of depleting natural resources. Our current development patterns are pulling the world towards an ecological suicide.

Today, the environment is racing towards a tipping point at which a permanent irreversible damage has been done to the planet earth. This impact arises from increasing level of pollution, unsustainable nature of consumption, and rapid

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destruction of natural resources. As awareness of the serious and far-reaching consequences of environmental problems continues to grow, people are looking for solutions to slow down, halt, and mitigate these effects. Humanity has a good reason to be tremendously hopeful regarding the ability of emerging technologies to save lives, improve health of environment and extend the life expectancy of people. Green and converging technologies have emerged as best and long-lasting solutions to protect the environment.

Green technologies are the application part of different branches of science, which try to conserve the natural resources and minimise the adverse impacts of human activity on environment. Green technologies have emerged as one of the significant means for achieving sustainability. Green technology enables to achieve sustainable development through ensuring sustainability. Green technology uses renewable natural resources that never deplete and apply innovative energy generation techniques. Converging technologies are enabling technologies and scientific knowledge systems that enable each other for the achievement of a common goal.

The development and deployment of green technologies is a viable method for sustainable development. Green technology is in the nature of balancing the fulfillment of human needs with the protection of environment and the natural resources so that these needs can be met not only in the present, but also in the indefinite future. It supports the promotion of a green economic system. Green technologies can reduce the carbon intensity or carbon footprint, promote energy and resource efficiency, and avoid serious environmental degradation. This improves environmental quality, human welfare and social equity, while reducing the risk of resource scarcities.

Green technology involves energy efficiency, recycling, safety and health concerns, renewable resources, and much more. Green and converging technologies are extensively used in different fields. The governments are hugely investing in these technologies. In the era of climate change, the transfer of green technologies from industrialised countries to developing nations remains one of the critical areas of global environment agenda.

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## **9.2 MEANING OF GREEN AND CONVERGING TECHNOLOGIES**

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Human activities continue to drive an increasing demand for natural resources, as manifested in technology choices, nature of consumption and the patterns of production. Technology largely becomes one of the key determinants of a country's productivity, allowing it to extract more value from the available resources, including labour, capital and natural resources.

Technology is the result of innovation and applied knowledge that is the direct or indirect result of the human mind. Technology allows people to become more efficient and to do things more intelligently that were not possible before. Technology refers to collection of techniques, skills, methods, tools, raw materials and processes used in the production of goods and services. Technology can also be embedded in machines, computers, devices and factories. Technology can be the knowledge of how to combine resources to produce desired products, solve problems, fulfill needs, or satisfy wants.

The current pace of technological advancements is exerting profound changes on the environment and the way people live. Large-scale exploitation of natural resources to achieve the developmental objectives has critically affected the environment. Also, it has radically disturbed the harmony between nature and humankind. Green technologies came into focus when the world felt that there is an urgency to protect the environment and ensure ecological stability through alternative technologies. While technology is important and serves social and practical uses in their own right, the benefits of green technologies transcend the sovereign borders of nations in protecting the environment. Accordingly, green technologies are known as environmentally healing technologies that minimise environmental damages created by the unprecedented level of socio-economic development of nations.

### ***Green Technologies***

Green technologies are the application of the environmental sciences and technology. There is no commonly accepted or internationally agreed definition of green technology, but the United Nations defines green technology as the technology that has the potential to significantly improve environmental performance as compared to other kinds of technology. Agenda 21 of the United Nations Conference on Environment and Development (1992) called green technology as “environmentally sound technology.” Based on Agenda 21, these technologies are geared to protect the environment, are less polluting, use all resources in a more sustainable way, recycle more of their wastes and products, and handle residual wastes in a more acceptable manner than the technologies for which they substitute.

Green technology has basically been defined as the development and application of products, equipment and systems that are used to conserve the environment and natural resources, which minimises and reduces the negative impact of human activities on environment. In other words, green technology does not only mean individual technologies but also systems, including know-how, procedures, goods and services, and equipment, as well as organisational and managerial procedures. Green technologies are characterised by innovation and comprise a set of products, services and systems that are continuously evolving. Green technology is a general term often used interchangeably with a number of other terms. These are: environmentally sound technology, clean technology, environmental technologies, climate related technologies, mitigation and adaptation technologies, clean technologies, low-carbon technologies, climate-smart and climate-friendly technologies.

Broadly, green technology includes both process and product technologies that generates low or no waste, and increase resource and energy efficiency. They also cover ‘end-of-the-pipe’ technologies for treating pollution. Significantly, green technologies encompass various aspects of technology, which reduce the human impact on the environment and enable to achieve sustainable development. Social equitability, economic feasibility and environmental sustainability are the key parameters for green technologies.

With respect to climate change, globally carbon intensive energy supply from carbon-intensive sources makes up the largest portion of sources of Greenhouse Gas emissions. The primary contributor to the atmospheric release of human-made CO<sub>2</sub> is the burning of fossil fuels. 80 per cent of such CO<sub>2</sub> arises as a result of burning oil, coal, and gas. However, green technology facilitates clean and

renewable energy that has the potential to significantly improve environmental performance in relation to other technologies.

The field of green technology encompasses a continuously evolving group of environment friendly methods and materials, from techniques for generating non-conventional energy sources such as solar and wind power to management tools to audit Greenhouse Gas emissions. Green technologies products aim to reduce waste, cut pollution, and even diminish fossil fuel use. Some of the important types of green technology products include energy creation products, green chemicals, sustainable or recyclable products, and technology that provide renewable alternative energy. These are solar panels and thermal heating discs. Solar panels, which can be installed on homes, apartments, and commercial buildings, use the sustainable heat of the sun to charge solar batteries that can be used for electricity. Thermal heating discs, which are used in swimming pools, suck the sun rays in and radiate them over the pool's surface, providing an alternative means of heating that avoids extensive fossil fuel.

### ***Converging Technologies***

The term 'convergence' is broad and appealing enough to be applied in many ways to science and technology. It is a kind of convergence on a common goal by insights and techniques of basic science and technology. Basically, converging technologies refer to the combination of new and relatively traditional technologies. Today technologies are converging through an increasing use of digital platforms to produce new combinatory technologies, which are expected to accelerate the pace of technological transformation. Such rapid changes are quickly spreading worldwide, with important resetting of the state of the art technologies.

Converging technologies are changing how people communicate, work, or organise their social lives. These converging technologies are also changing the way business organisations and governments operate and deliver services to people. Converging technologies are termed as enabling technologies and scientific knowledge systems that help each other for the achievement of a common purpose. In recent years, the term 'converging technologies' has taken on a new, specific meaning through nanotechnology. Singly or together, NBIC-technologies (Nano, Bio, Info, Cogno) are contributing towards these convergences.

Importantly, convergence is taking place not only in terms of technology, but also in other platforms. Converging technologies can be used to advance the goal of sustainable development. For example, in agriculture, the convergence of mobile and cloud computing, sensor deployment in machinery, genomics and other technologies promises to enable quantum leaps in precision farming, which will increase agricultural production and productivity. The same convergence is also motivating commercial alliances and mergers among companies in sectors such as farming equipment, computing and seed production.

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## **9.3 CHARACTERISTICS AND CATEGORIES OF GREEN TECHNOLOGIES**

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Green technologies remain significant in the light of the present state of environment, which is largely deteriorating. Green technology has emerged as

an important tool to improve the conditions of environment, while reducing production costs, unsustainable energy consumption, waste, or negative effects on the natural resources.

### 9.3.1 Characteristics of Green Technologies

Green technologies generally have the following *five* characteristics:

#### i) *High Efficiency Energy and Resource Use*

Energy use is one of the key determinants of socio-economic development. The type and nature of energy use significantly affects the environment. Green technologies help to achieve energy efficiency by using a reduced quantity of energy to generate the same or improved products, process or services. It is generally measured in a physical unit as the ratio between energy output and energy input. Also, resource efficiency refers to the ability to use a reduced quantity or volume of resources to produce the same or an improved service or product. It is generally measured as the ratio between useful material output and material input, both measured in physical terms.

Achieving energy efficiency through green technology has proved to be a cost-effective strategy for economic development, without necessarily increasing energy consumption and affecting the environment. Significant improvements in energy efficiency are achieved by adopting a more efficient technology or production process or by application of commonly accepted methods to reduce energy losses. For example, insulating a building allows it to use less heating and cooling energy to maintain a thermal comfort. Installing light-emitting diode bulbs, fluorescent lighting, or natural skylight windows reduces the amount of energy required to attain the same level of illumination compared to the use of traditional incandescent (Glowing or Luminous) light bulbs.

#### ii) *Low Costs*

Green technologies are low-cost technologies since they can simply be practiced or designed with a minimum of capital investment. It is a simple technology as the knowledge of green technologies and its application can be completely comprehended by a single individual, free from increasing specialisation and compartmentalisation. Overall, these technologies are easily fabricable, adaptable and repairable, and use little energy and resources. Green technologies allow for lower costs in production or processing, and are more accessible.

#### iii) *Non-generation of Secondary Pollutants*

Secondary pollutants are pollutants that form in the atmosphere, which are very harmful to humans. Secondary pollutants are not emitted directly from sources like vehicles or power plants, but when primary pollutants react in the atmosphere. Today, secondary pollutants are of much concern, as they can be formed from many different compounds. The phenomenon of photochemical smog, found in large cities, is a result of the interactions of primary pollutants with other molecules in the air such as molecular oxygen, water, and hydrocarbons. Green technologies do not create these secondary pollutants.

iv) ***Use of Renewable Energy and/or Materials***

The challenge posed by energy scarcity and climate change has spurred the development of new, cleaner energy technologies. The threat of climate change and the demand for new energy sources have changed the economics of existing energy systems. In order to meet the unprecedented energy demands for socio-economic development, it is necessary to rely on alternative technologies such as green technologies that facilitate the use of renewable and clean energy. At the moment, technological developments, for example, in solar, wind, shale gas, cellulosic biofuels, and geothermal energy are promising due to their potential to harness energy from existing renewable resources with zero carbon emissions. This protects the environment and natural resources, and preserves the ecosystem.

v) ***Beneficial to Human Health and Ecosystems***

Ecosystem function is the ability of the natural process of providing goods and services to meet human needs. Ecosystem services are the benefits that people obtain from ecosystems. Ecosystem services are attributes of the natural ecosystem function and process that are of great value to humans. These services are indispensable to the well-being of people since human health ultimately depends upon ecosystem friendly products and services. These include availability of fresh water, food and fuel sources, which are requisite for productive livelihoods of people. Green technologies protect the ecosystem and ensure continuous supply of ecosystem services. It also helps the efficient performance of ecosystem functions.

### **9.3.2 Categories of Green Technologies**

Green technology addresses the emerging issues of sustainability. Green technology covers broad areas of production and consumption technologies. Green technologies aim to protect the environment, repair the damage done to the environment in the past, conserve ecosystem and preserve the Earth's natural resources. Based on its specific functions, green technologies can be categorised as follows:

***Monitoring and Assessment Technologies***

Monitoring and assessment technologies are significantly used to measure and track the conditions of the environment, including the release of natural or anthropogenic materials of a harmful nature. The levels of pollution in land, water and air, and the nature of degradation of environment and depletion of natural resources will also be measured and assessed using these types of technologies.

***Prevention Technologies***

Prevention technologies are applied to minimise the production of environmentally hazardous substances or alter human activities in ways that largely minimise damage to the environment. These technologies encompass product substitution or the redesign of an entire production process rather than using new pieces of equipment.

**Control Technologies**

Control technology renders hazardous substances harmless before they enter the environment. In other words, these technologies act on substances released into the environment, rendering them harmless at source over the years. They perform the functions of filtering the hazardous substances. These types of green technologies could be used in large industrial plants to avoid the mixing of hazardous substances in air, water and land without appropriate filtering.

**Remediation and Restoration Technologies**

Remediation and restoration technologies aim at improving the environment that has been damaged by human activities. It embodies methods that are designed to improve the condition of ecosystems, which are degraded through naturally induced or anthropogenic impact.

**Check Your Progress 1**

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

1. Discuss the meaning of green and converging technologies.

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2. Explain the characteristics and categories of green technologies.

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**9.4 ROLE OF GREEN TECHNOLOGIES IN HEALTH AND SANITATION**

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Green technologies are extensively being used in the field of health and sanitation. With time, the quality of air, water and land is deteriorating, mainly due to the anthropogenic activities, unprecedented population growth, unplanned urbanisation, rapid industrialisation and unskilled utilisation of natural resources. The health and sanitation crises continue to affect the livelihoods of millions, and hamper the socio-economic development of most of the developing countries. In fact, the economic benefits of improved access to water and sanitation not only include a reduction of health costs, but also increase the productivity of people. Around 32 per cent of the world’s population around 2.4 billion people, still lack improved sanitation facilities, and 663 million people still use untreated

drinking water sources. Inadequate access to safe water and sanitation services, coupled with poor hygiene practices, kills and renders thousands of children sick every day.

The World Health Organisation (WHO) defines health as a state of “complete physical, mental and social well-being and not merely the absence of disease or infirmity.” Health is more commonly viewed as a desirable physical and mental state, characterised by strength, stamina, equanimity, and a lack of pain. Individual health depends on interacting genetic, environmental, social, and medical factors.

Globally, most of the negative health impacts come from air and water pollution. The air and water pollution is emitted by the coal and natural gas plants. These plants mainly use the traditional and conventional carbon intensive technologies that are linked with breathing problems, neurological damage, heart attacks, cancer, premature death, and a host of other serious problems. Alternative green technologies are environment friendly and are capable of removing pollutants from water at the same time; these also safeguard the health of affected population.

Wind, solar, and hydroelectric systems generate electricity with no associated air pollution emissions. Geo-thermal and biomass systems emit some air pollutants, though total air emissions are generally much lower than those of carbon intensive coal and natural gas-based power plants. Significantly, wind and solar energy do not require water to operate and thus do not pollute water resources or strain supplies by competing with agricultural, drinking water, or other important water needs of the people.

Green chemicals are important in many green technology products. These products aim to create the same effects as toxic, polluting chemicals, while reducing risk of poisoning and creating environmental harm. These green chemical products also reduce the negative impact on human health. These products based on green technologies include home cleaning agents made out of coconut and glycerin, insecticides that use orange or peppermint oil instead of toxic chemicals, and even green laundry detergent that can reduce water pollution.

Today, green technologies are extensively being used in settling, filtration, disinfection, coagulation that are some of the basic physical and chemical processes employed for water treatment. Also aerated lagoons, activated sludge or slow sand filter are some prominent processes. Sanitation is crucial for human and environmental health as well as social and economic development. Globally, about 2.5 billion people do not use an improved sanitation facility, and about 1 billion people practice open defecation, which is one of the main causes of drinking water pollution and diarrhoea incidences.

Every 20 seconds, a child dies as a result of poor sanitation practices and about 80 per cent of diseases in developing countries are caused by unsafe water and poor sanitation. Faecal contamination of water bodies is a worldwide problem, which is not only concerning developing countries that lack waste water treatment, but also industrialised societies, where highly populated urban centres draw their supply of drinking water. Improvement in sewage, excreta, and sludge management practices are urgently needed.

A sanitation system is a set of technologies, which in combination treat and manage human waste and waste water from the source of generation to the final

point of reuse or disposal. Sustainable sanitation systems not only protect and promote human health; they also protect the environment and natural resources. They are economically viable, socially acceptable, and technically and institutionally appropriate. The concept of sewage treatment is same as that of water treatment. This treatment has a greater significance, as it purifies the water according to its pollution level. It removes pollutants from waste water, household sewage, etc. It involves processes according to the kind of pollutants present.

EcoSan, produced in South Africa is a waterless toilet, a sanitation system that converts human waste into dehydrated, compostable materials. The waste can then be used as compost or disposed of at a traditional waste management facility. Many more such techniques can be experimented with. Focus must be on technologies that regenerate the environment and not harm it.

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## 9.5 GREEN TECHNOLOGIES AND FOOD SECURITY

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Famine and hunger have plagued humankind throughout history and remain critical problems. Most recently, attention has been focused on the problem of food security, which has become one of the main issues on the global agenda. Extensive application of modern conventional technology in agriculture has had a massive, often regional, impact on the environment, food security and human health. Nearly one billion people worldwide suffer from insufficient calories and nutrients; 2 billion have sufficient calories, but insufficient nutrients, and 2.5 billion consume excess calories, but many with insufficient nutrients.

Sustainability of different dimensions of food security requires a good understanding of the relations between agriculture production, societal needs, natural and economic processes involved in meeting these needs, as well as those related to environmental consequences. Green technologies play a significant role in addressing critical issues associated with the four dimensions of food security.

Green technologies are currently applied to combat biotic and abiotic stresses, raise crop and livestock productivity, improve soil fertility and make water available. These can potentially increase the agriculture productivity. Applications of green technologies in storage, refrigeration, transport and agro-processing innovations can address critical problems related to food accessibility. Science to produce high-nutrient staple crops can combat malnutrition, improving food utilisation and use.

Use of chemical fertilizers and overuse of water can cause environmental damage and represent an economic waste for small land holder farmers. New methods of nitrogen fixation and other fertilizer components that avoid the current capital and energy intensive methods of agricultural production could make nutrient supplementation more sustainable. For example, “N2Africa” is a large-scale, science-based development-to-research project focused on making nitrogen fixation to work for smallholder farmers growing legume crops in Africa. The National Research Institute for Chemical Technology of Nigeria has developed a neem-based fertilizer and an organic fertilizer from *Moringaoleifera*, which is environment friendly. New green technologies which are used to make biological fertilizers (composting, manure or dung) are more viable.



Irrigation technologies related to irrigation are low-cost and affordable, renewable energy-powered pumps and technologies for desalination and improved water efficiency can potentially make water more available for food production. Hydro- and solar-powered irrigation pumps increase access to irrigation, where manual irrigation pumps are strenuous to use because inadequate or expensive motorized pumps with recurring fuel costs that are financially out of reach for millions of small farmers. Affordable rainfall storage systems are also a potential technology for increasing the coverage area for irrigation.

A key aspect of accessing food is minimising food losses during production, storage and transport, and wastage of food. These are lack of easy access to markets, adequate storage facilities, affordable refrigeration and local crop-processing facilities. A number of post-harvest-loss green technologies are useful for storage, handling, refrigeration, transport and processing. Genetically improved variety of seeds can also limit (post-) harvest losses. Nano technology is being used to improve the preservation of crops. The Canadian International Food Security Research Fund and the International Development Research Centre support programmes to enhance the preservation of fruits.

To combat malnutrition, especially in developing countries, biofortification – or the breeding of critical micronutrients and vitamins into staple crops – has emerged as an effective approach. The most successful example of vitamin and micronutrient biofortification is the orange-fleshed sweet potato, developed at the International Potato Centre. Harvest Plus, as a global plant-breeding strategy has been developed for a variety of crops such as vitamin A-enriched cassava, maize and orange-fleshed sweet potatoes; and iron- and zinc-fortified rice, beans, wheat and pearl millet in over 40 countries. To address the growing decline in biodiversity, crop breeding strategies are highly dependent upon preservation of diversity of crops. Also, green technologies are extensively being used in organic farming, integrated pest management, sustainable livestock farming, fisheries and aquaculture.

### 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. Discuss the role of green technologies in health and sanitation.

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2. Explain the contribution of green technologies towards food security.

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## 9.6 CONCLUSION

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The humanity's unprecedented demand for natural resources has rapidly increased in the last few decades and has led to deterioration of the environment. Today, the environment is racing towards a tipping point at permanent and irreversible damage to planet earth. This impact arises from increasing level of pollution, unsustainable nature of consumption, and rapid destruction of natural resources. Green technologies have emerged as one of the significant means of achieving sustainability. This becomes the practical application of sustainability to everyday life. Green technology aims at sustainable development by ensuring sustainability. Green technology uses renewable natural resources that never deplete and apply innovative energy generation techniques.

Converging technologies are enabling technologies based on scientific knowledge systems that lead to the achievement of common environmental goals. Green technologies can reduce the carbon intensity, promote energy and resource efficiency, and avoid serious environmental degradation. This improves environmental quality, human welfare and social equity, while reducing the risk of resource scarcities. Basically, converging technologies refer to the combination of new and relatively traditional technologies. Today, technologies are converging through an increasing use of digital platforms to produce new combination of technologies, which are expected to accelerate the pace of technological transformation. Green technologies are extensively being used in the field of health and sanitation. Globally, most of the negative health impacts come from air and water pollution. The air and water pollutions are emitted by the coal and natural gas plants. Alternative green technologies, which are environment-friendly, are capable of removing pollutants from water and at the same time, safeguarding the health of affected populations.

Today, green technologies are being extensively used in desilting, filtration, disinfection, coagulation that are some of the basic physical and chemical processes employed for water treatment. Sanitation is crucial for human and environmental health, as well as social and economic development. Green technologies are currently applied to combat biotic and abiotic stresses, raise crop and livestock productivity, improve soil fertility and make water available. These can potentially increase agricultural production and productivity. Applications of green technologies in storage, refrigeration, transport and agro-processing innovations can address critical problems related to food accessibility. Also, green technologies are extensively being used in organic farming, integrated pest management, sustainable livestock farming, fisheries and aquaculture. This Unit examined the pertinent role of green and converging technologies in environmental protection, with special reference to health, sanitation and food security.

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## 9.7 GLOSSARY

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**Anthropogenic Age:** It is also called anthropocene. This age is characterised by instances when human activities substantially alter the earth's environment.

**Biotic Stress:** It occurs as a result of damage done to an organism by bacteria, virus, fungi etc.

**Coagulation:** It is process that starts instantly after an injury to the lining of blood vessel.

**End of the Pipe Technologies:** These are measures deployed to decrease or eliminate the emission of substances into the atmosphere that can harm environment.

**Food Security:** All people, at all times, have physical, social, and economic access to sufficient, safe and nutritious food that meets their food preferences and dietary needs for an active and healthy life.

**Organic Farming:** Agricultural system that uses ecologically based pest controls and biological fertilizers derived largely from animal and plant wastes and nitrogen-fixing cover crops. This is a response to the environmental harm caused by the use of chemical pesticides and synthetic fertilizers in conventional agriculture, It has numerous ecological benefits.

**Sanitation:** The maintenance and delivery of clean, hygienic conditions that help prevent disease through services such as drinking water supply, garbage collection, and safe disposal of human waste.

**State of Art:** It refers to the highest level of development. The development can be of a device, technique or method at a particular time.

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## 9.9 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

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### Check Your Progress 1

#### 1. Your answer should include the following points:

- Green technologies have basically been defined as the development and application of products, equipment and systems that are used to conserve the environment and natural resources. These minimise and reduce the negative impact of human activities on environment.
- Green technologies do not only mean individual technologies but a whole system, including know-how, procedures, goods and services, and equipment, as well as organisational and managerial procedures. Green technologies are characterised by innovation and comprise a set of products, services and systems that are continuously evolving.
- Converging technologies refer to the combination of new and relatively traditional technologies. Today, technologies are converging through an increasing use of digital platforms to produce new combinatory technologies, which are expected to accelerate the pace of technological transformation.
- Converging technologies are termed as enabling technologies and scientific knowledge systems that help each other for the achievement of a common purpose.

#### 2. Your answer should include the following points

- High efficiency energy and resource use.
- Low costs.
- Non-generation of secondary pollutants.
- Use of renewable energy and/or materials.
- Beneficial to human health and ecosystems.
- Monitoring and assessment technologies.
- Prevention technologies.
- Control technologies.
- Remediation and restoration technologies.

## Check Your Progress 2

### 1. Your answer should include the following points:

- Globally, most of the negative health impacts come from air and water pollution. The air and water pollutants get emitted by the coal and natural gas plants. These are linked with breathing problems, neurological damage, heart attacks, cancer, premature death, and a host of other serious problems.
- Green technologies are capable of removing pollutants from water and at same time safeguarding the health of affected populations. Wind, solar, and hydroelectric systems generate electricity with no associated air pollution emissions. Geo-thermal and biomass systems emit some air pollutants, though total air emissions are generally much lower.
- Significantly, wind and solar energy do not require water to operate and thus do not pollute water resources or strain supplies by competing with agriculture, drinking water, or other important water needs of the people.

### 2. Your answer should include the following points:

- To combat malnutrition, especially in developing countries, biofortification or the breeding of critical micronutrients and vitamins into staple crops has emerged as an effective approach.
- Genetically improved varieties of seeds can also limit (post-) harvest losses. Nanotechnology is being used to improve the preservation of crops.
- Hydro and solar-powered irrigation pumps increase access to irrigation.
- Also, green technologies are extensively being used in organic farming, integrated pest management, sustainable livestock farming, fisheries and aquaculture.
- New methods of nitrogen fixation and other fertilizer components that avoid the current capital and energy intensive methods of agricultural production could make nutrient supplementation environmentally more sustainable.

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## **UNIT 10 ROLE OF EDUCATION IN SUSTAINABLE DEVELOPMENT\***

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### **Structure**

- 10.0 Objectives
- 10.1 Introduction
- 10.2 Meaning and Importance of Education
- 10.3 Role of Education in Sustainable Development
- 10.4 Vision on Education for Sustainable Development
- 10.5 Conclusion
- 10.6 Glossary
- 10.7 References
- 10.8 Answers to Check Your Progress Exercises

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### **10.0 OBJECTIVES**

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After reading this Unit, you should be able to:

- Discuss the meaning and importance of education in the context of sustainable development;
- Explain the role of education in achieving sustainable development; and
- Explore the relationship among education, development and environment.

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### **10.1 INTRODUCTION**

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Education is seen as a big force; a force that not only contributes to national development, but also sustainable development. It is a key to development, be it social, economic, political or environmental. Education promotes development of knowledge and skills required to achieve sustainable development (SD). It encourages promotion of economic well-being, social equity, democratic values and much more. Education for Sustainable Development (ESD) enables people and citizens to learn as to how to preserve earth resources which are limited in availability. The ESD has the objective of empowering present and future generations to meet their needs using a balanced and integrated approach to the economic, social and environmental dimensions of SD.

As already noted in Unit 1, concept of sustainable development or SD emerged as a response to a growing concern for human impact on the environment. The concept of SD has been broadly defined by the World Commission on Environment and Development (1987) as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. This definition is quoted in almost all the Units of this Course. The definition acknowledges that while development may be necessary to meet human needs and improve the quality of life, it must happen without depleting the capacity of the earth’s resources to meet the current and future needs.

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\* Contributed by Dr. R.K. Sapru, Professor of Public Administration (Retired), Panjab University, Chandigarh

The SD movement has grown on the basis of a concept of sustainability that protects both the interests of future generations and the capacity of the planet earth to regenerate. In the 21<sup>st</sup> century, sustainability refers generally to the capacity of the biosphere and human civilization to co-exist. The Rio Declaration on Environment and Development (1992) laid down 27 principles of sustainability. One such principle is the Declaration that says: “In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process, and cannot be considered in isolation from it. Eradicating disparities in living standards in different parts of the world is essential to achieve sustainable development and meet the needs of majority of people.”

Sustainable development can be defined as those developmental activities that do not degrade the environment and can be carried on for a long period of time. One of the central principles of sustainable development is living within the limits of consumption of natural resources. Thus, the goals of economic and social development must be defined in terms of sustainability in all countries, developed or developing, market-oriented or centrally planned.

It may be noted that UN Conference on Environment and Development (popularly known the Earth Summit) also debated in 1992 and confirmed its resolve to promote the 3 pillars of SD, namely Economy, Society and Environment, as interdependent and mutually reinforcing concepts. To achieve SD, these sectors (pillars) need to come together. The economic, social or societal and environmental sectors are all critically important and interdependent. A healthy prosperous society relies on a healthy environment to provide food and resources, safe drinking water and clean air for its citizens. This Unit discusses the role of education in achieving SD and explores the interaction among economy, society and environment.

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## 10.2 MEANING AND IMPORTANCE OF EDUCATION

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Before we discuss the role of education in sustainable development, it is imperative to understand the meaning and importance of role of education in sustainable development. Role is defined as “the function assumed or part played by a person or thing in a particular situation”. The definition of a role “is a part or character someone performs or the function or position of a person”. An example of a role is the position of the nurse in a hospital. Merriam-Webster defines role as a function or part performed, especially in a particular operation or process.

Education is a process of developing the personality and creativity of the individuals so that they can in turn help in promoting a healthy society. Education is actually a process, which influences individual capabilities, social environment, economic development, ethical surroundings and above all cultural adaptability. Education is expected to evolve principles, methodologies and guidelines for the application of knowledge that could benefit society. It is also expected to provide knowledge and skills for addressing the issues of development. It must also enable people and students to develop an understanding and a perspective of the physical and social environment.

The importance of education can be interpreted from the reply to the question asked to Aristotle. The question was ‘How much better educated men were than

those who were uneducated'. Aristotle's reply was 'As much as the living are from the dead.' Education thus is a process to shape the quality of life of individuals and through them of the society and the world. It is an investment in the human resources. In the present age of science and technology, it has been increasingly realised that one needs to be educated not only to become a better human and social being, but also a creative and productive being. Looking at the changes taking place around the world, it is being widely felt that the kind of world we will bequeath to our children and grandchildren may not be a better one as a result of environmental degradation that results from political and economic decisions made today. A matter of grave concern is that those who reap the fruits of economic development today may be making future generations worse off by excessively damaging and destroying the natural resources and polluting the earth's environment.

'Sustainable development' was a major focus of the United Nations Conference on Environment and Development (UNCED) held in Brazil in June 1992. The achievement of sustainable development globally is likely to prove as one of the greatest challenges to the world community in view of the continued population growth and rising levels of consumption per capita. As the World Commission on Environment and Development observed, efforts to achieve sustainable development are being carried out amidst the additional pressure of such global difficulties as "climate change, ozone depletion, and species loss" (WCED, 1987).

As we all know, legacy of the concept of sustainable development is attributed to the Report of the World Commission on Environment and Development 'Our Common Future'. In this context, sustainable development secures a balance between economic development and ecological sustainability. Both economic and environmental systems need a certain minimum threshold value to survive. In essence, sustainable development is a process of change in which the exploitation of resources, direction of investments, orientation of technological development, and institutional change, are all in harmony and enhance both current and future potential to meet human needs and aspirations (*Ibid.*).

The concept of sustainable development rejects the traditional view that economic development is a necessity, but environmental protection is a luxury. The World Commission Report (*Ibid.*) noted that measures of success in sustainable development must take account of the context and of the need to meet social challenges. The sustainability aspect requires that the environmental administrators should aim to:

- i) Maintain ecosystems and related ecological processes essential for the functioning of the biosphere;
- ii) Preserve biological diversity by ensuring the survival and conservation of all species of flora and fauna in their natural habitats.
- iii) Observe the principle of optimum sustainable yield in the exploitation of living natural resources and ecosystem;
- iv) Prevent or abate significant environmental pollution or harm;
- v) Establish adequate standards of environmental protection;
- vi) Undertake or require prior assessments to ensure that major law policies, projects, and technologies contribute to sustainable development; and
- vii) Make all relevant information public without delay in all cases of harmful or potentially harmful releases of pollutants, especially radioactive releases.



Education for Sustainable Development (ESD) has been defined as “education that allows every human being to acquire the knowledge, skills, attitudes and values necessary to shape a sustainable future. In other words, ‘the ESD is the process of equipping students with the knowledge, skills and attributes needed to work and live in a way that safeguards environmental, social and economic well-being, both in the present and for future generations’. The key ESD issues relate to climate change, disaster risk reduction, biodiversity, poverty reduction, and sustainable consumption. Education for SD consequently promotes competencies like critical thinking, imagining future scenarios and making decisions in a collaborative way. Thus, education for SD requires far-reaching changes in the way education is often practiced today. The ESD would be meaningful when it is linked with issues that the world is facing today. It must be given a global outlook. Education thus plays an important and decisive role in sustainable development.

Education for SD should include the following thrusts:

- Promotion and improvement of basic education related to SD;
- Reorientation of existing education at all levels- primary (basic), secondary, higher in order to address SD.
- Development of public awareness and understanding of sustainability.
- Learning and development of training methods in the world of sustainable development. In this way, SD depends upon the provision of specialised training programmes to ensure that all sectors of society have the necessary skills to perform their work in a sustainable manner.

### Check Your Progress 1

- Note:** i) Use the space given below for your answer  
ii) Check your answer with that given at the end of the Unit.

1. Discuss the meaning and importance of education in sustainable development.

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## 10.3 ROLE OF EDUCATION IN SUSTAINABLE DEVELOPMENT

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Sustainable development, as already noted, was formally initiated for the world community in the year 1992. In it, education occupies an important place. It is linked with environmental themes. The tragedy triggered by the COVID-19 pandemic presents the world with an incredible opportunity to build back better. Academic institutions, be they colleges, schools or universities, must double their efforts to ensure that the world’s policymakers and leaders are provided with the information they need to solve the increasingly complex developmental problems.

Thus, education for sustainable development promotes research and provides information needed to solve sustainable developmental problems arising out of human-made decisions. Education as an investment in human resources plays an important role among the factors, which contribute to sustainable development. Let us read about them now:

- **ESD promotes and encourages sustainable society**

Quality education is an important key and tool for achieving a more sustainable society. This was vociferously emphasised at the UN World Summit in Johannesburg in 2002, where the reorientation of current education systems was outlined as the key to SD. It may be noted that education for SD promotes the development of the knowledge, skills, values and actions required to create a sustainable society, which ensures environmental protection and conservation, promotes social equity and encourages economic well-being. Traditionally, India has been a sustainable society. In order to promote the value of sustainable development in education, the Indian government has directed its various education departments to actively work on an Environment Education (EE) component as a part of the curriculum.

- **ESD aims to develop knowledge about environment**

The concept of ESD developed basically from environmental education, which has sought to develop the knowledge, skills, values, and behaviour in people to give more attention to protection of environment. The aim of ESD is to enable people to make decisions and carry out actions, without compromising the planet earth. The COVID-19 pandemic has led to global crisis that is severely restrictive in nature and could hamper the ability to meet unprecedented challenges.

College, school and university closures have kept most of the students worldwide out of educational institutions. Online education facilities are not accessible to those who are without technological gadgets like computers, laptops and tablets. A majority of students are managing online teaching on their mobiles but most affected have been the abject poor and resourceless. The pressure on families is intense. Jobs are being lost and incomes are down. Climate change and environmental degradation are happening much faster than expected. The consequences are being felt around the world. The wildfires in America, Australia, Europe and Siberia have broken records for their ferocity. In 2020, flooding in South Asia has forced more than 25 million people to abandon their homes. The point is that the ESD aims to broaden knowledge and behaviour of people about the human-made problems. The aim of ESD is to enable people to make decisions and carry out actions, without compromising the earth's resources.

- **The ESD outlines integration of principles and practices of sustainable development**

The goal of the decade (2005-2014), as outlined by UNESCO, is to integrate the principles, values and practices of sustainable development into all aspects and dimensions of education. Thus, it aims to encourage changes in behaviour that will create a more sustainable future.

One of the most important aspects of the DESD is the recognition that ESD must engage a wide range of stakeholders- the government and non-government organisations, civil society, and general public.

To promote ESD, the UN Decade of Education for SD, 2005-2014 (DESD) was adopted by the UN General Assembly with the United Nations Educational, Scientific and Cultural Organisation (UNESCO) designated as the lead agency for promotion throughout the decade. The decade pursues a global vision “of a world where everyone has the opportunity to benefit from quality education and learn the values, behaviour and lifestyles required for a sustainable future and positive societal transformation.”

In its International Implementation Scheme for DESD, UNESCO states that ESD is fundamentally about behaviour and values, particularly respect for others, including those of present and future generations, for the environment and for the earth’s resources (UNESCO,2006).Education enables us to understand ourselves and others. It attempts to strengthen our links with the wider natural and social environment. This understanding serves as a durable basis for building respect. Along with a sense of justice, responsibility, exploration and dialogue, ESD aims to enable us to adopt behaviours and practices, which will lead us to live a full life, without being deprived of basic human needs and demands.

- **ESD focuses on environmental themes and concerns**

The ESD offers a beautiful vision of future with the dominant focus on environmental concerns. It also addresses themes such as poverty alleviation, citizenship, peace, ethics, governance, justice, human rights, gender, equality, corporate responsibility, natural resources management and biological diversity. It is generally recognised that certain characteristics carry values for the successful implementation of ESD, reflecting the equal importance of both the learning process and the outcomes of the education process (adapted from ‘UN Decade of Sustainable Development’, 2005-2014).

The focus of ESD is on curriculum to be prescribed for elementary, secondary and higher education. The curriculum is mostly interdisciplinary in nature allowing an institutional approach in policy-making. The ESD shares the values and principles that underpin sustainable development. It, in fact, promotes critical thinking, problem-solving and action-orientation, all of which develop confidence facing challenges related to sustainable development. It permits learners to participate in decision-making related to the design and content of educational programmes.

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## **10.4 VISION ON EDUCATION FOR SUSTAINABLE DEVELOPMENT**

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In the beginning of 21<sup>st</sup> century, the international community realised the value of education for sustainable development. It now strongly feels that we need to foster through education the values, behaviour and lifestyles required for a sustainable future. Education for sustainable development has an important role to play in our lifestyles and behaviour. Education is seen as a process of learning as to how to make decisions that affect us. It is concerned with the future of the

economy, environment and social well-being of all communities. Building the capacity for such future-oriented thinking is a key task of education.

This is a new vision of education. This vision helps the people of all ages to realise this aim of education in the context of sustainable development. It helps students to understand the world in which they study, play and live a little better. It enables them to address the complex problems of society and environment such as illiteracy, poverty, wasteful consumption, environmental degradation, urban decay, population growth, gender inequality, health, and violation of human rights that threaten our future. This vision of education stresses on a holistic, integrated and interdisciplinary approach to development of knowledge and skills needed for a sustainable future as well as changes in values, behaviour, and lifestyles. This requires us to reorient educational curricula to programmes, policies and practices in order to empower people (especially youth) to make decisions and act in culturally appropriate and locally relevant ways to address and redress the environmental problems that threaten our common future. This enables people of all ages to develop and evaluate an alternative vision of a sustainable future and fulfil this vision through working creatively with others.

Thus, basic education is a key to nation’s capacity to develop and achieve sustainability targets. The basic education can improve agricultural productivity, enhance the status of women, reduce population growth rates, increase environmental protection and generally raise the living standards. “The pandemic has firmly established the need to place sustainability towards the top of the top of India Inc’s Agenda” (The Economic Times, 2020).

**Check Your Progress 2**

- Note:** i) Use the space given below for your answer.  
ii) Check your answer with that given at the end of the Unit.
1. In what way does education help in achieving sustainable development?

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## 10.5 CONCLUSION

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Quality education for sustainable development is recognised as an important goal of the UN General Assembly (Resolution in 2015). “Education is the most important single factor in achieving rapid economic development and technological progress and increasing a social order founded on the values of freedom, social justice and equal opportunity. Programmes of education lie at the base of the effort to forge the bonds of common citizenship to harness the energies of the people and to develop the natural and human resources of every part of the country.” In a word, education is regarded as the key to development and the fundamental pre-requisite of social and economic justice, which are the twin pillars of the Welfare State. In a world based on science and technology, it

is education that determines the level of prosperity, welfare and security of the people.

The primary concern of education for SD is the improvement of the quality of life of people without damaging the environment. It offers a bold and beautiful vision of our shared future- a future in which hundreds of millions of people no longer go to bed hungry every day, where poverty no longer harms one in ten people, and where quality education and lifelong learning opportunities are available to all. The heartbreaking reality is that we have failed to follow this roadmap. In other words, we are unable to implement this vision of a better world.

The underlying principles of ESD, as outlined by UNESCO, highlight the importance of respect and care for its diverse forms. This involves the protection and restoration of the earth's ecosystem, respect for the human rights, and regard for cultural diversity. In developed as well as developing countries, the diversity of programmes offered at present provides a good basis for any action plan on Education for SD and useful opportunities for inter-sectoral collaboration on common issues and areas on climate change.

Some sustained efforts need to be made (involving youth, religious organisations, senior citizen associations) to campaign together for the reduction of emission of Greenhouse Gases, population control, and better sanitation programmes, etc. The climate change campaign could serve as a model of good practice for achieving sustainable development goals. Innovation and new projects, ESD and related education sectors need to be popularised and encouraged by involving youth, senior citizens' associations, religious institutions, civil society groups etc. In this way the ESD would really contribute to the country's prosperity and happiness of the people. It would also ensure the social and economic well-being of the people.

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## 10.6 GLOSSARY

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**Ecosystem:** A group of living organism that live and interact with each other within a specific environment.

**Environmental Degradation:** Deterioration in the environment, caused by depletion or decay of resources eg., water, air and soil.

**Natural Habitats:** These are areas characterised by certain environmental conditions and by plant and animal species typical of such areas.

**Climate Change:** It means a weather pattern of Planet Earth. Climate changes are majorly caused by human activities such as fossil fuel burning, which increases heat trapping Greenhouse Gases. This leads to increase in surface temperature precipitating global warming.

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## 10.8 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

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### Check Your Progress 1

1. **Your answer should include the following points:**

- Education helps in development of personality of individuals.
- It influences human capabilities, social environment, economic development, ethical surroundings and cultural adaptability.
- It shapes quality of life.
- It makes individuals better social beings.
- Right education would help in maintaining ecosystems, biodiversity, optimum sustainable yield, as well as curbing environmental pollution.
- Education for Sustainable Development (ESD) is a new concept that requires adequate attention of policy makers and those involved in implementation of environmental legislation.

### Check Your Progress 2

1. **Your answer should include the following points:**

- Education for Sustainable Development (ESD) promotes and encourages sustainable society.
- ESD aims to develop knowledge about environment.
- ESD outlines integration of principles and practices for sustainable development.
- ESD focuses on environmental themes and concerns.