

3. Sustainable Development

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We enjoy nature! We visit forests, mountains, rivers, oceans, wildlife for our recreation. But what about our future generation? We should think that they also should be able to enjoy the nature. **"Sustainable development is the development that fulfils the needs of the present; without compromising the ability of future generations to meet their own needs."** The aim of sustainable development is to balance our economic, environmental and social needs for now and future generations.

3.1 Need for sustainable development

Sustainability is improving quality of human life; while living within the carrying capacity of supporting ecosystems. If natural resources on the earth are conserved, maintained and enhanced, the ecological processes would work smoothly. The raw materials for the industry, food, water, fuel, fodder come from the environment. The environment also absorbs the waste created by our developmental activities. Thus it acts as a source and also a sink for us.

Sustainable development will lead to true economic growth. This will be reflected in equitable distribution of economic benefits; which in turn will help to bridge the gap between poor and rich people in the society.

If we look at the scenario around us, we can

see an increase in population followed by excessive use of natural resources. This is because of the increased demands and needs of growing population. As the economic conditions of the people in urban area started improving, their purchasing power increased. People started purchasing electronic goods, metal and plastic articles. This led to consumerism.

Advancement in technologies, globalization, rapid changes in lifestyle, access and desire to luxury goods and consumerism are the main causes of rapid depletion of natural resources and deterioration of the environment.

3.2 Sustainable Development Goals (SDG)

Sustainable development goals are a collection of seventeen global goals designed to be a "blue print to achieve a better and more sustainable future for all." The SDGs set in 2015 by United Nations (UN) General Assembly and intended to be achieved by 2030.



Goal 1

End poverty in all its forms everywhere



Goal 2

End hungers, achieve food security and improved nutrition and promote sustainable agriculture..



Goal 3

Ensure healthy lives and promote well being for all, at all ages.



Goal 4

Ensure inclusive and equitable education and promote lifelong learning opportunities for all.



Goal 5

Achieve gender equality and empower all women and girls.



Goal 6

Ensure availability and sustainable management of water and sanitation for all.



Goal 7

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



Goal 8

Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.



Goal 9

Built resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.



Goal 10

Reduce inequality within and among the countries.



Goal 11

Make cities and human settlements inclusive, safe, resilient and sustainable.



Goal 12

Ensure sustainable consumption and production patterns.



Goal 13

Take urgent action to combat climate change and its impacts.



Goal 14

Conserve and sustainably use the oceans, seas and all marine resources for sustainable development.



Goal 15

Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and halt and reverse land degradation and halt biodiversity loss.



Goal 16

Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.



Goal 17

Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Activity 1

Write at least 2 steps to achieve the goals of sustainable development from 1 to 17.

3.3 Challenges for sustainable development

1) Population growth -

As the world population is growing there is a peer pressure on the available resources. Today world's population is approximately 7.7 billion and India's population is approximately 1.32 billion. The rate at which these resources are being exploited by such a large population, they would not last for longer time.

2) Exploitation of natural resources -

Exploitation of natural resources started to emerge on an industrial scale in 19th century. Timber, coal, metals, oil, natural gas, subsoil minerals, water and many more resources are being exploited for industrial and commercial uses. Progress and development of new technologies and equipments, changes in life styles led to use of various appliances at work place, home, in industry and agriculture. This led

to over use of natural resources. To reduce the exploitation of these natural resources is a big challenge.



3) Poverty -

In underdeveloped and developing countries, poverty is a big challenge. Sustainable development must also look for the basic needs of poor and deprived people, as they also aspire for better life.

4) Unequal distribution of resources -

Consumption of resources per capita in developed countries like U.S is about 50 times greater than the consumption per capita in developing countries. U.S.A. alone with 4% of world population, consumes about 25% of the world's resources.

Even within the country, there is disparity in the use of resources like water. When large dams are constructed, huge tracts of forests and agricultural lands of affected people are utilized for the dam. These local people, whose livelihood are linked to this land are displaced to some other places.

5) Consumerism -

In growing economy, people have more purchasing power. This leads to more consumption of various goods for luxury. Production of a variety of electronic, plastic, metal goods are a major source of attraction/desire in the market.

To follow the path of sustainable development, people have to change their life style and do with less. In practice, people are reluctant to do so. This is one of the big challenges to sustainable development.



6) Education and unemployment -

Illiteracy is a major challenge for sustainable development. Poor people can't afford to educate their children. They are unable to get employment as they have no quality education. This vicious circle continues. Population increase in the country is also one of the reasons for the unemployment.

7) Awareness -

Common people are not at all aware about the fact that resources on this earth are limited and that non-renewable resources will not even get generated once they are used up. This is the reason that these resources should be used judiciously. People should realize what are their actual needs before purchasing.

8) Government Policy -

To achieve the goals of sustainable development, the government has to take certain hard decisions and implement different schemes. It should restructure the cost of all goods, considering the environmental cost of their

production. Similarly non-conventional energy sources like solar, wind energy, biogas based appliances should be subsidized. Rain water harvesting systems also should be given subsidies. Government should implement schemes to achieve sustainable goals.

3.4 Sustainable agriculture

Sustainable agriculture refers to the ability to produce food without causing irreversible damage to ecosystem and to human health. It has biophysical, socio-economic and environmental aspects.

- The impact of various agricultural practices should not affect crop productivity in the long term.
- Farmers should add the necessary inputs (use of bio fertilizers and bio pesticides etc.), manage the resources.
- In agricultural practices use natural resources such as water and land carefully.
- A way of moving towards that goal is to make a gradual shift from chemical agriculture to organic farming.

Organic Farming

Organic farming is a system which avoids use of chemical fertilizers, pesticides and animal feed additives etc.

It uses advance knowledge along with traditional methods such as crop rotation, mixed cropping, mixed farming, green manures, bio-fertilizers and bio-pesticides.

Organic farming is based on the following principles.

- Nature is the best role model for farming since it uses adequate natural resources.
- Soil is a living system and should not be used for dumping chemicals.

- Organic fertilizers in the soil are significant contributors to its fertility and must be protected and nurtured at any costs.

Elements of sustainable agriculture

- Cropping methods
 - 1) Mixed farming
 - 2) Mixed cropping
 - 3) Crop rotation
- Biofertilizers
- Biopesticides
- Integrated Pest Management

Cropping Methods

1) Mixed farming

Mixed farming is a system of farming crops, and raising livestock, poultry fish etc. together on a farm.

The advantages of mixed farming are :

- Greater stability of yield over different seasons.
- Better use of resources.
- Better control of weeds, pest and diseases.
- Suitable for small farmers.

2) Mixed cropping

In this method different crops are grown in the same field. Crops are mixed in such a way that they can benefit each other. For example, 'Tur' is planted in between the rows of cotton plants. Because of such practice atmospheric nitrogen is fixed in the soil by 'Tur' and used by both plants.

Advantages of mixed cropping are :

- Minimizing the risk of total crop failure
- Pest and disease control
- Weed control
- Protection of soil from erosion
- Improves soil fertility.

Activity 2

Conduct an interview of a farmer to collect information about mixed cropping along with the reasons.

3) Crop rotation

Monocotyledon crops repeatedly grown in the same place eventually depletes various nutrients. Crop rotation is the practice of growing a series of different crops sequentially in the same space.

Crop rotation gives the following benefits :

- Maintains the balance of nutrients.
- Improve soil structure and fertility.
- Reduces requirement of other fertilizers.
- Inhibits the growth of different pests.
- Keeps the land under continuous production.

• Bio-fertilizers

Bio-fertilizers are living organisms that enrich the nutrient quality of the soil. It refers to the use of microbes instead of chemicals to enhance the nutrition of the soil. Bio-fertilizers does not cause pollution thus they are eco friendly.

Advantages of bio-fertilizers

- Improves soil texture and increases yield of crops
- Do not allow pathogens to flourish
- Eco friendly and cost effective
- Do not cause environmental pollution

There are various bio fertilizers like Rhizobium, Azotobacter, Azospirillum, phosphate solubilizing bacteria and mycorrhiza, which are available in the market.

• Bio pesticides :

Bio pesticides are derived from natural material such as animals, plants, bacteria, and certain minerals.

In India, a range of neem products such as the extracts of neem kernel, seed and leaf are used as bio pesticides. Some farmers are using other pesticides made from herbs such as basil, mint, marigold and lemongrass etc.

Bio pesticides have the following advantages -

- They are less toxic than the chemical ones.
- They generally affect only the target pests and closely related organisms. While conventional pesticides affects organism like birds, insects and mammals.
- Bio pesticides are effective in very small quantities and decompose quickly. Further, the pollution problems are avoided.

Genetically modified crops (GM)

Genetically modified crops are made by using such technology which involves inserting a specific gene into the genome of plant species. This plant species is then grown by tissue culture. The new plants, having the specific gene in them, are useful as they are resistant to certain pests or diseases. Therefore use of chemical pesticides is considerably reduced. However, there are certain disadvantages of GM crops, which should also be considered while using them.

Do you know?

Cotton is one of the major fibre crops of global significance. In India, 162 species of insect pests attack different stages of cotton. Out of this bollworms are most damaging and loss inducing pests of cotton. The frequent and regular crop failures in the last 15 years have been attributed to bollworms. Although a wide variety of pesticides are used to minimize the pest damage, there were new serious problems such as resistance to pesticides, reoccurrence of secondary pests,

environmental contamination due to indiscriminate use and unspecific product. Bt cotton has proved useful in countries where it has been introduced earlier.

What is Bt cotton?

The Bt is a short form of soil bacterium *Bacillus thuringiensis*. This bacterium synthesizes proteins called 'endotoxins' which are highly toxic to certain insects. They kill the insect by acting on the epithelium tissues of midgut of caterpillars. When this gene is introduced in the cotton plant, it starts producing this toxin and destroying the pest.

This method is useful for protecting the crops without pesticides. The introduction of Bt cotton has provided growers with a new tool for managing bollworms in cotton. Reduced pesticide use, improved crop management effectiveness, improved yield and profitability and improvement opportunity to grow cotton in areas of severe pest infestation are some of the advantages of Bt cotton.

Integrated Pest Management

Integrated pest management (IPM) is a pest control strategy with following features :

- Focus on control and not eradication of pests. Attempts at total eradication are costly and environmentally destructive and may actually worsen the situation. It is better to decide on acceptable pest levels and take action when the levels are exceeded.
- Select the best suitable varieties for local conditions and use natural predators and parasites.
- Observe regularly and keep records of pest behaviour.
- Choose mechanical means such as hand picking, insect barriers pheromone, traps, etc.

- Use minimum chemical insecticides as the last option.

IPM is an environment friendly approach that significantly reduces or eliminates the use of chemical pesticides.

Impact of chemical pesticides on environment and human health.

- Within 5-10 years, pest can develop immunity to pesticides through natural selection and pesticides become ineffective.
- Elimination of natural predators of pests.
- Generally less than 2% of the insecticide applied to crops reaches the target pests. The rest contaminates the air, water sources, soil and human food.
- The pesticide that used for the target species affects the non-target organisms like human beings and animals. Every year in the world, large number of farm workers and their children are affected due to careless handling of chemical pesticides.
- Pesticides remain in the harvest as residue and enter the food chain. Such residues persist for a long time. Most of the food items that we consume have been recorded for the presence of pesticides. Animals and birds are also seriously affected.

Activity 3

Visit agricultural service centre nearby. Prepare a table of commonly used pesticides and fertilizers along with their impacts on humans and environment.

Do you know?

Sikkim is 100% organic state!

In 2016, Sikkim became India's first organic state. Today all farming in Sikkim is carried out without the use of chemical fertilizers and pesticides. This makes agriculture more ecofriendly with healthy grain production.

1,90,000 acres of cultivable land in Sikkim is certified as organic. Thousands of composting pits are installed for making compost. Compulsory training on organic farming as part of capacity building is introduced. Due to this production and exports are growing. Biodiversity has flourished and tourism is also growing.

Water management

In sustainable agriculture, proper water management is essential. Sustainable water management techniques includes :

1. Drip irrigation

This technique delivers water directly to the plant root. It reduces the evaporation that happens with sprinkler system. In addition to this, timers can be scheduled for watering as per requirement. Drip irrigation can save up to 80% water as compared to conventional irrigation.

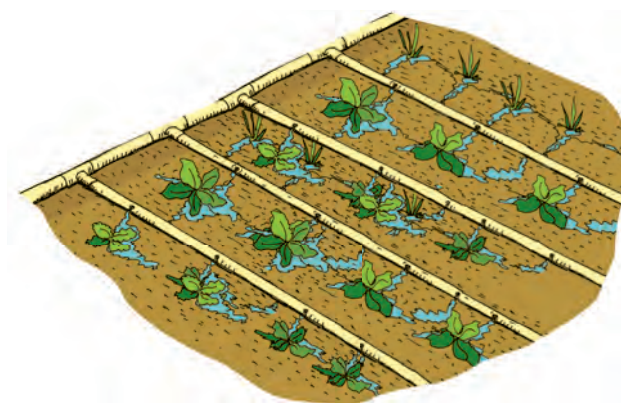


Figure 3.1 : Drip irrigation

2. Farm ponds

These are built in their own farm to harvest rainwater for use throughout the year.

3. Irrigation scheduling

Smart water management is careful monitoring of the weather forecast, as well as soil and plant moisture and accordingly schedule irrigation, avoiding overwatering to the crops.

4. Drought-tolerant crops

Growing crops that are appropriate to the regions climate. Selecting crop species that are native to arid regions and are naturally drought-tolerant.

5. Compost and mulching

Compost or decomposed organic matter used as fertilizers, has been found to improve soil quality also increase its water holding capacity.

Mulching is a material spread on the top of the soil to conserve moisture. It is made from organic and inorganic materials such as straw or wood chips that will breakdown into compost, further increasing the soil fertility and will retain water.

Activity 4

Make a visit to an organic farm in your area. Arrange an interview with the farmer to understand the ways and means of organic farming. Make a report of it.

Do you know?

Rotational grazing is a process in which livestock are moved between fields to help regrowth of pasture. Good grazing management increases the fields' water absorption capacity and decreases water runoff ultimately making pastures more

drought-resistant. Increased soil organic matter and better forage cover are also water-saving benefits of rotational grazing.

Activity 5

Arrange a poster competition on the theme 'wastage and conservation of natural resources' in your college/school.

3.5 Role of individual, community and government in sustainable development

Role of Individual

If we want to follow the path of sustainable development, we should use all kinds of resources like food, paper, water, energy, forest, land etc. very carefully at our individual level. This can be achieved by following simple steps and '4 R' principles - Reduce, Reuse, Recycle and Recover in our day-to-day life. Details of this topic are discussed in Chapter 2.

Role of Community

Any village or community can change the whole scenario of their village if they are inspired by a person or an incidence. Ralegan siddhi is a very promising example of community participation, leading to sustainable development and prosperity.

Role of Government

Government of India is giving emphasis on achieving the goals of sustainable development. For this, government has defined certain policies and programmes. Some of them are as follows.



1) Swachh Bharat

Abhiyan - It was launched on 2nd october 2014 by

Prime Minister to make India clean. It is based on

Sustainable Development Goal number (SDG) 6. The aims of this project are to provide sanitation facilities to each and every family. It includes constructions of toilets and to form solid and liquid waste disposal systems. Another two aims of this project are to make villages clean, safe as well as adequate drinking water supply by 2019.



2) Beti Bachao, Beti Padhao Yojana - This is a campaign of Government of India, launched on 22nd January 2015 by Prime Minister based on SDG goal number 4 and 5. It

aims to address the issue of declining child sex ratio (0-6 years). It initially focused on multisector action in hundred districts throughout the country where there was low child sex ratio.



3) Ujjwala Yojana - This project was launched on 1st May 2016 by Prime Minister. It is based on SDG 5. In this

nearly 50 million L.P.G. connections were distributed to women of below poverty line families. A budgetary provision of Rupees 800 billion was made available for this. The purpose of this scheme is to provide clean fuel to women for cooking. The women will be free from health hazards due to fire wood and cow-dung burning. These houses will be smoke free which benefits all including children.



4) Pradhan Mantri Awas Yojana - This is an initiative taken by Government

of India, in which affordable housing would be provided to poor people. This was launched by Prime Minister in 2015. This project targets to build 20 million affordable houses by 2022. It has two components urban and rural. This addresses sustainable goal no. 11.



5) Sarva Shiksha Abhiyan -

This is an Indian Government Programme, aimed at universalization of elementary education in time bound manner. This programme was Pioneered by Primer minister to achive SDG goal 4. It aimed to educate all children between age 6 to 14 by 2010. However, the time limit has been pushed forward indefinitely.



6) Namami Gange Abhiyan - This Abhiyan was launched by Prime Minister in June 2014 with a

budget out lay of Rupees 20 thousand crore to accomplish the twin objectives of effective abatement of pollution, conservation and rejuvenation of our national river, Ganga.

Do you know ?

Mangroves store 50 times more carbon in their soils by surface area compared to tropical forest; and 10 times more than temperate forest. That is why it is very important to conserve mangroves.

Activity 6

Find out more information on different Government schemes related to sustainable development.

Do you know ?

Gazi is a typical fishing community in Kenya. The people are poor and their children have no formal education. These people conserved their mangroves and established new mangrove forest in their region. In return, they received large amount of money by selling carbon credits. The villagers invested this money into childrens education and clean water. By conserving the mangroves these people achieved following goals of sustainable development.

Goal 1 (end poverty)

Goal 4 (quality education)

Goal 6 (clean water and sanitation)

Goal 13 (climate action)

Goal 14 (conserve marine resources)

Activity 7

Which of the following actions are sustainable and which are not? Why ?

1. A dozen of plastic bottles are purchased because there is a 'sale' going in a mall.
2. The newspapers, plastic and metal articles are separated from the waste and given to kabadiwala.
3. Shopping bags of old cloths are made and used for everyday shopping.
4. Tree plantation is conducted at public places.
5. People, staying in the same area go to office by making car pool.
6. A farmer sows 7-8 variety of crops on his farm.
7. Cattle, chicken rearing on the same farm is

done along with the crops.

8. A strong weedicide is sprayed on the farm to control the weeds.
9. Green manure are grown on the farm for obtaining N, P and K.
10. College/ School management committee decides to follow green audit for the college/school.

Exercise for Journal Assignment

- 1) What is difference between development and sustainable development? Explain with suitable examples.
- 2) Make a table of commonly used chemical pesticides and fertilizers. Write down their impacts on human health and environment.
- 3) Write success story of Ralegan Siddhi with respect to sustainable development Goals.
- 4) Explain the role of individuals and community for sustainable lifestyle.
- 5) Explain the any two elements of sustainable agriculture.
- 6) Write information about some Bt varieties being cultivated in India.
- 7) Explain the sustainable development schemes being implemented in India.
- 8) Enlist the sustainable development goals. Explain which and how the goals among these are being achieved in your locality.

