UNIT 5 NATURAL RESOURCE EXPLOITATION

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5.1 INTRODUCTION

The socio-economic strength of a society can be determined by the quantum and quality of available natural and human resources and the capabilities for its optimal utilisation. The basic challenge for attaining such strength lies in science and technological innovation and economic determinism on the one hand, and the limitations imposed by our ecological systems on the other. The development process in all its dimensions should expand within the ecosystems, cautiously balancing the environmental constraints and economic activities for its short term as well as long term implications. In this endeavour, an integrated approach projecting inter-sectoral complementarities is required in our development strategy rather than an exclusive sectoral growth approach.

Sustainable development and poverty reduction depend on the protection and sustainable management of our common property resources, including forests, biodiversity, and water resources. Improved management of these natural resources is the key to achieving sustainable development. The poor, especially in rural areas, heavily depend on the productivity and environmental services of these natural resources for the livelihoods and quality of life. While economic development has led to dramatic improvements in the quality of life in developing countries, gains have been unevenly distributed and a large part of the world's population remains extremely poor. At the same time, environmental degradation and loss of natural assets with resulting health costs and productivity losses have offset the benefits of economic growth and have damaged critical life-support systems.

The need for sustainable development is evident from the following global statistics:

1. There will be 2 billion more people on the planet over the next quarter of a century, nearly two-thirds of the world's population living in water-scarce or water-stressed areas by 2025.

2. Food production needs to double over the next 40 years at a time when almost 23 percent of the world's agricultural land has been degraded.

3. Almost 12 million hectares of forest are lost each year; there has been overexploitation and decline of more than 60 percent of the world's marine fisheries.

4. Small island nations are threatened with annihilation from rising sea levels due to climate change.

In both rural and urban areas, the poor and marginalised are often the least able to protect themselves from natural resource degradation, disasters, and environmental health threats, including pollution. One and a half billion people still do not have access to safe drinking water or adequate sanitary facilities. Unsafe drinking water, health damages from air pollution, vector-born diseases, and other environmental factors account for more than 25 percent of the mortality and morbidity among the poor in the developing world.

People in developing countries are increasingly concerned about their environment and especially the impacts of pollution and natural resource degradation on their health and prospects of sustainable livelihoods. Environmental factors impose considerable human, economic, and social costs in many developing countries, threatening the foundation for sustained improvements in living standards. The economic costs of environmental degradation have been estimated at 4 to 8 percent of Gross Domestic Product (GDP) annually in many developing countries.

As the United Nations Environmental Programme's (UNEP) 2000 report points out, the 'time for a rational, well-planned transition to a sustainable system is running out fast', yet we continue to adopt a business-as-usual approach to decision-making, in all the three main sectors of economic development, i.e., in the agriculture, industry and service sectors thereby increasing the chance that our global systems will crack and begin to crumble. The stages of development moving from primarily agriculture to the present combination of agriculture, industry and service sectors enables one to understand the changing pattern of exploitation of natural resources. This unit discusses the natural resources and their exploitation in agriculture, industry etc. in the historic and modern times. The modern lifestyle and consumerism is also discussed in relation to sustainable development.

Objectives

After studying this unit, you should be able to:

- analyse the indicators of sustainable development in all sectors in your own regional/national context; and
- discuss the key factors that lead to stress, in the context of natural resources and sustainable agricultural development

5.2 HISTORICAL PERSPECTIVE AND STAGES OF DEVELOPMENT

Until about 8,000 years ago, people were foragers of wild food. Some specialised in hunting, in fishing along coasts or in lakes or rivers while others depended on seeds and fruits. By about 8000 BC, people had settled to the agricultural mode of life. With the advent of copper, bronze and Iron Age, efficient tools were manufactured and the economy developed. Trade in goods like cotton, spices and others flourished. With the development of the maritime trade, the realm of world commerce expanded. The ushering in of the industrial revolution brought with it tremendous advances in manufacturing process of goods that led to the exploration of markets and procurement of natural resources through colonisation.

The process of industrialisation with increasing emphasis on rapid manufacturing of large quantities of products (mass production) ushered in an era of reckless exploitation of the natural resources. The same industrialisation approach was taken up by the colonies that subsequently became independent developing states. The culture of 'mass production' affected even the agriculture sector, increasing per-hectare yield becoming the prime objective, irrespective of the short and long-term damage to soil productivity and land degradation. Along with 'mass-production', the pattern of exchange of goods changed. Monetary system for exchange of goods evolved and the service sector became a growing and distinct part of economy. This trajectory of development has been rapidly consuming natural resources. If the entire developing world were to adopt this unsustainable model of development and reach

the production and consumption levels of the developed world, the result would be catastrophic and may even make this planet an inhospitable or uninhabitable place for man and his future generations.

5.3 SECTOR-WISE PARAMETERS OF SUSTAINABLE DEVELOPMENT

The parameters of sustainable development that measure sustainability or sustainable development performance are known as indicators. The indicators include environmental, economic and social factors. These indicators signal:

- the pressure that society puts on the environment (in the form of pollution and resource depletion).
- the resulting state of the environment (especially the incurred changes) compared to the desirable (sustainable) states.
- the response by human activity mainly in the form of political and societal decision, measures and policies.

Table 5.1: Sustainable development indicator framework

SOCIAL

Theme	*Sub-theme*	*Indicator*
Equity	Poverty	Percent of Population Living below Poverty Line Gini Index of Income Inequality Unemployment Rate
	Gender Equality	Ratio of Average Female Wage to Male Wage
Health	Nutritional Status	Nutritional Status of Children
	Mortality	Mortality Rate Under 5 Years Old Life Expectancy at Birth
	Sanitation	Percent of Population with Adequate Sewage Disposal Facilities
	Drinking Water	Population with Access to Safe Drinking Water
	Healthcare Delivery	Percent of Population with Access to Primary Health Care Facilities Immunisation against Infectious Childhood Diseases Contraceptive Prevalence Rate
Education	Education Level	Children Reaching Grade 5 of Primary Education Adult Secondary Education Achievement Level
	Literacy	Adult Literacy Rate
Housing	Living Conditions	Floor Area per Person
Security	Crime	Number of Recorded Crimes per 100,000 Population
Population	Population Change	Population Growth Rate Population of Urban Formal and Informal Settlements

ENVIRONMENTAL

Theme	*Sub-theme*	*Indicator*
Atmosphere	Climate Change	Emissions of Greenhouse Gases
	Ozone Layer Depletion	Consumption of Ozone Depleting Substances
	Air Quality	Ambient Concentration of Air Pollutants in Urban Areas
Land	Agriculture	Arable and Permanent Crop Land Area Use of Fertilizers Use of Agricultural Pesticides
	Forests	Forest Area as a Percent of Land Area Wood Harvesting Intensity
	Desertification	Land Affected by Desertification
	Urbanisation	Area of Urban Formal and Informal Settlements
Oceans, Seas and Coasts	Coastal Zone	Algae Concentration in Coastal Waters Percent of Total Population Living in Coastal Areas
	Fisheries	Annual Catch by Major Species
Fresh Water	Water Quantity	Annual Withdrawal of Ground and Surface Water as a Percent of Total Available Water
	Water Quality	BOD in Water Bodies Concentration of Faecal Coliform in Freshwater
Biodiversity	Ecosystem	Area of Selected Key Ecosystems Protected Area as a % of Total Area
	Species	Abundance of Selected Key Species

ECONOMIC

Theme	*Sub-theme*	*Indicator*
Economic Structure	Economic Performance	GDP per Capita Investment Share in GDP
	Trade	Balance of Trade in Goods and Services
	Financial Status	Debt to GNP Ratio Total ODA Given or Received as a Percent of GNP
Consumption and Production Patterns	Material Consumption Energy Use	Intensity of Material Use Annual Energy Consumption per Capita Share of Consumption of Renewable Energy Resources Intensity of Energy Use
	Waste Generation and Management	Generation of Industrial and Municipal Solid Waste
		Generation of Hazardous Waste Management of Radioactive Waste Waste Recycling and Reuse
	Transportation	Distance travelled per Capita by Mode of Transport

INSTITUTIONAL

Theme	*Sub-theme*	*Indicator*
Institutional Framework	Strategic Implementation of SD	National Sustainable Development Strategy
	International Cooperation	Implementation of Ratified Global Agreements
Institutional Capacity	Information Access	Number of Internet Subscribers per 1000 Inhabitants
	Communication infra-structure Science and Technology	Main Telephone Lines per 1000 Inhabitants Expenditure on Research and Development as a Percent of GDP
	Disaster Preparedness	Economic and Human Loss Due to Natural Disasters and Response

Source: http://www.un.org/esa/sustdev/natlinfo/indicators/isd.htm

SAQ 1

Gather relevant data from various sources (Census, Human Development Report, etc.) for the indicators mentioned above and analyse it to ascertain the sustainable development performance of your country. You can do this exercise over a period of time.

The indicators of sustainability cover stewardship of both natural and human resources. Stewardship of human resources includes consideration of social responsibilities such as working and living conditions of labourers, the needs of rural communities, and consumer health and safety both in the present and the future. Stewardship of natural resources covers maintaining or enhancing land and other vital natural resource base for the long term.

5.3.1 Agriculture

Agricultural practices changed dramatically and went through a major transition as traditional farming methods were largely replaced by modern high-intensity agriculture with new technologies, mechanisation, increased chemical use, specialisation and government policies that favoured maximising production. Advances in crop breeding and new technologies made this possible. This highly mechanised approach to agriculture dramatically increased crop productivity, especially by the introduction of high-yielding varieties of grains, typically accompanied with the use of mechanised equipment, fossil fuel energy, synthetic fertilizers and pesticides and irrigation. The agriculture practices changed; for example, the high-yielding hybrids, first developed in Mexico in the 1940s, characterised an extended planting season and quicker maturation.

The Green Revolution is a prime case of such a change. Often hailed as a miracle for its immediate and remarkable results in increasing crop yields, it spread to Asia, Africa, South America, and elsewhere in the 1960s and 70s and several countries achieved record harvests of wheat, maize, and rice, and many doubled food production in a period of 30 to 40 years. The world food production increased faster than the population from the 1950s through the mid 80s, when it levelled off and the per capita production began to fall. In general, these increases in world food production came not from an increase in the area under cultivation, but from higher yields on existing cropland.

The methods of the Green Revolution often replaced low-impact traditional crop varieties and farming systems that had developed over hundreds of years in consonance with regional soils and climate – without absorbing the accumulated indigenous knowledge. Although these changes have had many positive effects and

reduced many risks in farming, there have also been significant losses. Prominent among these are topsoil depletion, groundwater contamination, the decline of family farms, continued neglect of the living and working conditions of farm labourers, increasing costs of production, and the disintegration of economic and social conditions in rural communities.

Although many assume that the environmental effects of agriculture are small compared to the effects of industry, agriculture is now the primary unregulated source of water pollution in the United States (US) and the main source of soil degradation in the world. This modern agriculture causes soil erosion and loss of soil fertility; pollution and eutrophication of freshwater and coastal marine ecosystems; depletion and contamination of groundwater; habitat destruction; intensive energy consumption; release of greenhouse gases; and impacts from production and use of fertilizers and pesticides. Agricultural practices can disrupt natural ecosystems and their processes to the point of altering their ability to provide critical ecosystem services that are necessary not just for agriculture but to sustain life on this planet. For example, soil provides such critical ecosystem functions as regulation of air and water quality and the attenuation of wastes, essential to any terrestrial ecosystem.

Fig.5.1: The resource intensive modern agricultural practices have improved productivity but have brought many environmental and health-related problems in their wake

A systems perspective is essential to understand agriculture's sustainability. The system is envisioned in its broadest sense, from the individual farm, to the local ecosystem, and to communities affected by the farming system both locally and globally. An emphasis on the system allows a larger and more thorough view of the consequences of farming practices on both human communities and the environment. A systems approach gives us the tools to explore the interconnections between farming and other aspects of our environment. A systems approach also implies interdisciplinary efforts in research and education. This requires not only the input of researchers from various disciplines, but also farmers, farm workers, consumers, policymakers and others. Making the transition to sustainable agriculture is a process. For farmers, the transition to sustainable agriculture normally requires a series of small, realistic steps. Family economics and personal goals influence how fast or how far participants can go in the transition. It is important to realise that each small decision can make a difference and contribute to advancing the entire system further on the "sustainable agriculture continuum". The key to moving forward is the will to take the next step.

Finally, it is important to point out that reaching toward the goal of sustainable agriculture is the responsibility of all participants in the system, including farmers, labourers, policymakers, researchers, retailers, and consumers. Each group has its own part to play, its own unique contribution to make to strengthen a sustainable agriculture community.

A. Plant Production Practices: Sustainable production practices involve a variety of approaches. Specific strategies must take into account topography, soil characteristics, climate, pests, local availability of inputs and the individual grower's goals. Despite the site-specific and individual nature of sustainable agriculture, several general principles can be applied to help growers select appropriate management practices:

a) Selection of site, species and variety:

1. Factors such as soil type and depth, previous crop history, and location (e.g. climate, topography) should be taken into account before planting.
2. Whenever possible, pest-resistant crops should be selected which are tolerant of existing soil or site conditions.
3. Preventive strategies, adopted early, can reduce inputs and help establish a sustainable production system.

b) Diversity: Diversified farms are usually more economically and ecologically resilient. While monoculture farming has advantages in terms of efficiency and ease of management, the loss of the crop in any one year could put a farm out of business and/or seriously disrupt the stability of a community dependent on that crop. By growing a variety of crops, farmers reduce economic risk and are less susceptible to the radical price fluctuations associated with changes in supply and demand. Properly managed, diversity can also buffer a farm in a biological sense. For example, in annual cropping systems, crop rotation can be used to suppress weeds, pathogens and insect pests. Also, cover crops can have stabilising effects on the agro-ecosystem by holding soil and nutrients in place, conserving soil moisture with mowed or standing dead mulches, and by increasing the water infiltration rate and soil water holding capacity. Cover crops in orchards and vineyards can buffer the system against pest infestations by increasing beneficial insect populations and can therefore reduce the need for chemical inputs.

Optimum diversity may be obtained by integrating both crops and livestock in the same farming operation. This was the common practice for centuries until the mid-1900s when technology, government policy and economics compelled farms to become more specialised. Mixed crop and livestock operations have several advantages. *First*, growing row crops only on more level land and pasture or forages on steeper slopes reduce soil erosion. *Second*, pasture and forage crops in rotation enhance soil quality and reduce erosion; livestock manure, in turn, contributes to soil fertility. *Third*, livestock can buffer the negative impacts of low rainfall periods by consuming crop residue that in "plant only" systems would have been considered crop failures.

Fig.5.2: Soil must be nurtured well to get sustained yields

c) Soil management: Crop management systems that use greater inputs of water, nutrients, pesticides, and/or energy for tillage to maintain yields often impair soil quality. In sustainable systems, the soil is viewed as a fragile and living medium that must be protected and nurtured to ensure its long-term productivity and stability. Methods to protect and enhance the productivity of the soil include using cover crops, compost and/or manures, reducing tillage, avoiding traffic on wet soils, and maintaining soil cover with plants and/or mulches. Regular additions of organic matter or the use of cover crops can increase soil aggregate stability, soil tilth, and diversity of soil microbial life.

d) Efficient use of inputs: Many inputs like pesticides, fertilizers, herbicides etc are used in sustainable agriculture. Sustainable farmers, however, maximise reliance on natural, renewable, and on-farm inputs. Equally important are the environmental,

social, and economic impacts of a particular strategy. Converting to sustainable practices does not mean simple input substitution. Frequently, it substitutes enhanced management and scientific knowledge for conventional inputs, especially chemical inputs that harm the environment on farms and in rural communities. The goal is to develop efficient, biological systems which do not need high levels of material inputs.

Growers frequently ask if synthetic chemicals are appropriate in a sustainable farming system. Sustainable approaches are those that are the least toxic and least energy intensive, and yet maintain productivity and profitability. Preventive strategies and other alternatives should be employed before using chemical inputs from any source. However, there may be situations where the use of synthetic chemicals would be more "sustainable" than a strictly non-chemical approach.

e) Consideration of social, cultural assets and lifestyle choices: Management decisions should reflect not only environmental and economic considerations, but also cultural and lifestyle choices. For example, adoption of some technologies or practices disturbs the work choices of women or the cultural life of a village traditionally connected with agriculture. Overemphasis on monetary returns from agriculture may adversely impact on lifestyle. Therefore, management decisions that promote sustainability, nourish the environment, enrich the community and the individual socially and culturally are required.

B. Animal Production Practices: The integrated crop and livestock operations are highly complementary both biologically and economically. The integration presently usually takes place not at the farm level or at a higher level- but at business trade levels through intermediaries. This is the result of a trend toward separation and specialisation of crop and animal production systems. It is, however, encouraging to note that despite this trend, there are still many farmers who integrate crop and animal systems. Some of the specific points that livestock producers need to address are listed below.

a) Animal Selection: The animal enterprise must be appropriate for the farm or ranch resources. Farm capabilities and constraints such as feed and forage sources, landscape and climate must be considered in selecting which animals to produce. For example, ruminant animals can be raised on a variety of feed sources including range and pasture, cultivated forage, cover crops, shrubs, weeds, and crop residues. There is a wide range of breeds available in each of the major ruminant species, i.e., cattle, sheep and goats. Hardier breeds that, in general, have lower growth and milk production potential, are better adapted to less favourable environments with sparse or highly seasonal forage growth.

b) Animal nutrition: Feed costs are the largest single variable cost in any livestock operation. Feed costs can be kept to a minimum by monitoring animal condition and performance and understanding seasonal variations in feed and forage quality on the farm.

c) Breeding: Use of quality germplasm to improve herd performance is another key to sustainability. In combination with good genetic stock, adapting the breeding season to fit the climate and sources of feed and forage reduce health problems and feed costs.

d) Herd Health: Animal health greatly influences breeding success and weight gains, two key aspects of successful livestock production. Unhealthy stock wastes feed and require additional labour. A herd health programme is critical to sustainable livestock production.

f) Grazing Management: Most adverse environmental impacts associated with grazing can be prevented or mitigated with proper grazing management. The number of stock per unit area (stocking rate) must be correct for the landscape and the forage sources. Sufficient control should be exercised to reduce overuse in some areas while other areas go unused. Prolonged concentration of stock that results in permanent loss of vegetative cover on uplands or in riparian zones should be avoided. However,

small scale loss of vegetative cover around water or feed troughs may be tolerated if surrounding vegetative cover is adequate.

g) Confined Livestock Production: Animal health and waste management are key issues in confined livestock operations. The moral and ethical debate taking place today regarding animal welfare is particularly intense for confined livestock production systems. The issues raised in this debate need to be addressed. Confined livestock production is increasingly a source of surface and ground water pollutants, particularly where there are large numbers of animals per unit area. Expensive waste management facilities are now a necessary cost of confined production systems. Waste is a problem of almost all operations and must be managed with respect to both the environment and the quality of life in nearby communities. Livestock production systems disperse stock in pastures so that the wastes are not concentrated and do not overwhelm natural nutrient cycling processes; these of late, have become a subject of renewed interest.

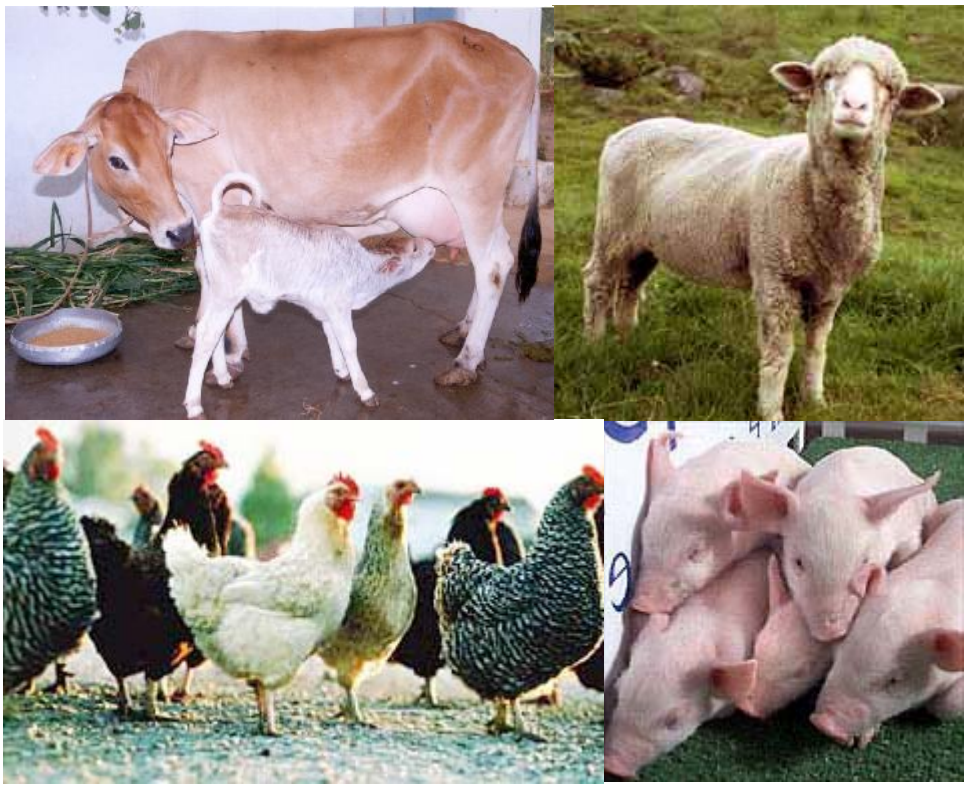


Fig.5.3: Livestock management is an important issue in sustainable agriculture

C. Water: Water is the principal resource that has helped agriculture and society to prosper, and it has been a major limiting factor when mismanaged. An extensive water storage and transfer system allows crop production to expand to very arid regions. In drought years, limited surface water supplies have prompted overdraft of groundwater and consequent intrusion of salt water, or permanent collapse of aquifers. Several steps should be taken to develop drought-resistant farming systems even in “normal” years, including both policy and management actions: 1) improving water conservation and storage measures, 2) providing incentives for selection of drought-tolerant crop species, 3) using reduced-volume irrigation systems, 4) managing crops to reduce water loss, or 5) not planting at all.

The most important issues related to water quality involve salinisation and contamination of ground and surface waters by pesticides, nitrates and selenium. Salinity has become a problem wherever water of even relatively low salt content is used on shallow soils in arid regions and/or where the water table is near the root zone of crops. Tile drainage can remove the water and salts, but the disposal of the salts and other contaminants may negatively affect the environment depending upon where they are deposited. Temporary solutions include the use of salt-tolerant crops, low-volume irrigation, and various management techniques to minimise the effects of salts on crops. In the long-term, some farmland may need to be removed from

production or converted to other uses. Other uses include conversion of row crop land to production of drought-tolerant forages, the restoration of wildlife habitat or the use of agro-forestry to minimise the impacts of salinity and high water tables.

Another way in which agriculture affects water resources is through the destruction of riparian habitats within watersheds. The conversion of wild habitat to agricultural land reduces fish and wildlife through erosion and sedimentation, the effects of pesticides, removal of riparian plants, and the diversion of water. The plant diversity in and around both riparian and agricultural areas should be maintained in order to support a diversity of wildlife. This diversity will enhance natural ecosystems and could aid in agricultural pest management.

D. The Economic, Social & Political Context: Sustainable agriculture requires a commitment to changing public policies, economic institutions, and social values as the "food system" extends far beyond the farm. It involves the interaction of individuals and institutions with contrasting and often competing goals including farmers, researchers, input suppliers, farm workers, unions, farm advisors, processors, retailers, consumers, and policymakers. Therefore strategies and approaches covering a variety of domains are necessary to create a more sustainable food system. The strategies will range from concentrated efforts to alter specific policies or practices, to the longer-term tasks of reforming key institutions and rethinking of economic priorities. Areas of concern where change is most needed include the following:

E. Food and Agricultural Policy: New policies at national, state and local government level are needed to simultaneously promote environmental health, economic profitability, and social and economic equity. For example, commodity and price support programmes could be restructured to allow farmers to realise the full benefits of the productivity gains made possible through alternative practices. Tax and credit policies could be modified to encourage a diverse and decentralised system of family farms rather than corporate concentration and absentee ownership. Research policies could be modified to emphasise the development of sustainable alternatives. Marketing orders and cosmetic standards could be amended to encourage reduced pesticide use. Coalitions must be created to address these policy concerns at the local, regional, and national level.

F. Land use: Conversion of agricultural land to urban uses is of particular concern, as rapid urbanisation and escalating land values threaten farming on prime soils. Existing farmland conversion patterns often discourage farmers from adopting sustainable practices and a long-term perspective on the value of land. Comprehensive new policies are needed to protect prime soils and regulate development. Sustainable agriculture research and education can play a key role in building public support for agricultural land preservation. Educating land use planners and decision-makers about sustainable agriculture is an important priority.

G. Labour: In general, the conditions of agricultural labour are generally far below accepted social standards and legal protections in other forms of employment. Policies and programmes are needed to address this problem, working toward socially just and safe employment that provides adequate wages, working conditions, health benefits, and chances for economic stability. The needs of migrant labour for year-around employment and adequate housing are a particularly crucial problem needing immediate attention. To be more sustainable over the long-term, labour must be acknowledged and supported by government policies, recognised as important constituents, and carefully considered when assessing the impacts of new technologies and practices.

H. Rural Community Development: Sustainable agriculture presents an opportunity to rethink the importance of family farms and rural communities. Economic development policies are needed that encourage more diversified agricultural production on family farms as a foundation for healthy economies in rural communities. In combination with other strategies, sustainable agriculture practices

and policies can help foster community institutions that meet employment, educational, health and cultural needs.

I. Consumers and the Food System: Consumers can play a critical role in creating a sustainable food system. Through their purchases, they send strong messages to producers, retailers and others in the system about what they think is important. Food cost and nutritional quality have always influenced consumer choices. The challenge now is to find strategies that broaden consumer perspectives, so that environmental quality, resource use, and social equity issues are also considered in shopping decisions. At the same time, new policies and institutions must be created to enable producers using sustainable practices to market their goods to a wider public. Coalitions organised around improving the food system are one specific method of creating a dialogue among consumers, retailers, producers and others. These coalitions or other public forums can be important vehicles for clarifying issues, suggesting new policies, increasing mutual trust, and encouraging a long-term view of food production, distribution and consumption.

J. Sustainable Agriculture Indicators: Agricultural indicators are one of the first major steps taken to establish criteria for sustainable agriculture. Within each broad indicator specific, measurable parameters are defined. Table 5.1 gives the ten indicators and their parameters.

Table 5.2: The indicators and parameters of sustainable agriculture

Sl.No.	***Indicator***	***Parameters***
1.	Soil fertility/health	1. Number of beneficial organisms (e.g. earth worms per square meter) 2. Number of predatory mites 3. Number of beneficial micro-organisms 4. Soil organic carbon (measure of healthy soil structure)
2.	Soil loss	1. Soil cover index (proportion of time soil is covered with crop; protects against leaching and erosion, promotes water binding) 2. Soil erosion (loss of top soil in percentage per annum or in tonnes/hectare/annum)
3	Nutrients	1. Amount of inorganic Nitrogen (N)/ Phosphates (P)/ Potassium (K) applied (per ha or per tonne of product) 2. Proportion of N fixed on site/imported 3. Balance of N/P/K over crop rotations 4. Emissions of N-compounds to air
4	Pest Management	1. Amount of pesticides (active ingredient) applied (per ha or per tonne of product) 2. Type applied (profiling, positive list, weighting factor) 3. Percentage of crop under Integrated Pest Management (IPM)
5	Biodiversity	1. Level of biodiversity on site: number of species (e.g. birds, butterflies); farm landscape; habitat for natural predator systems (e.g. hedgerows, ponds, non-cropped areas) 2. Level of biodiversity off-site: cross-boundary effects
6	Product Value	1. Total value of produce per hectare 2. Yield of target product in tonnes per hectare

		3. Conforming to quality specifications: nutritional value, including minerals; pesticide residues; foreign bodies, etc. 4. Ratio of solid waste re-used/recycled over solid waste disposed to landfill
7	Energy	1. Balance: total energy input/total energy output, including transport where relevant 2. Ratio renewable over non-renewable energy inputs 3. Emissions to air (greenhouse and pollutant gases)
8	Water	1. Amount of water used per hectare or tonne of product for irrigation 2. Leaching and runoff of pesticides to surface and ground water 3. Leaching and runoff of N/P/K (nutrients) to surface and ground water
9	Social/Human Capital	1. Group dynamics/organisational density (farmer groups) 2. (Rural) community awareness of relevance and benefits of sustainable practices/connectivity to society at large 3. Rate of innovation
10	Local Economy	1. Amount of money/profit reinvested locally 2. Percentage of goods/labour/services sourced locally 3. Employment level in local community

You will study about these aspects in greater detail in the course **Agriculture and Environment** (MED 007) of this programme**.** You may like to attempt an exercise before studying further.

SAQ 2

Describe your perception of the differences in farm life today and a century ago, and give reasons for changes.

5.3.2 Industry

According to the United Nations, *'Industry has a key role to play in achieving the goals of sustainable development as supplier of goods and services required by the society, as a source of job creation and as an active participant in community life'*.

The historical path of industrialisation may be summarised as under:

1. 1880s: The English System: Apply power driven machines to old pre-industrial methods.
2. 1850-1920: The American System: Standardisation of products and interchangeability of parts.
3. 1920-1960: Taylorism: Assembly line, vertical integration and optimisation of individual tasks.
4. 1960-1985: Quality Control: Add to Taylorism, new techniques, quality control, and applications of computers to individual functions.
5. 1990: Flexible and holistic Approach: Functional integration, flexibility, decentralisation, horizontal management, teamwork and networking.

Rapid strides in technology have contributed to the rapid spread of industrialised production, beginning from the industrial revolution in England. Future directions of change in production technology are to move from mass production of uniform goods and services to those tailored to the needs and likings of individuals. Flexible manufacturing systems, connected decentralised production units as new 'factories', horizontal management rather than Taylorism are the emerging trends. This trend has the potential to revitalise Craft-like production systems that build upon creativity, imagination, intuition and skills embedded in local cultures. These approaches are emerging as strong candidates for innovative technologies for sustainable and environmentally friendly production systems wide spread adoption of which can move a substantial part of manufacturing activity away from non-sustainable mass-production systems.

With reference to existing industry, Agenda 21 states *'Business and industry, including trans national corporations, play a crucial role in the social and economic development of the country…..Increasing prosperity, a major goal of the developmental process, is contributed primarily by the activities of business and industry. Business enterprises, large and small, formal and informal, provide major trading, employment and livelihood opportunities'*. Since the Earth Summit, business and industry have broadly improved environment performance, while simultaneously creating jobs and improving living standards.

Their commitment to this goal has been apparent through many innovative initiatives by several business groups and individual companies. Some of them are:

1. **Responsible Entrepreneurship:** This initiative provides the managerial, technical and financial resources to contribute to the resolution of environmental challenges.
2. **Corporate Environmental Management Tools:** This integrates sustainable development considerations into everyday business. It will contribute to the harmonisation of environmental regulation and enforcement and will further improve corporate policy and practice.
3. **Technology Cooperation:** The private sector has a crucial role to play in the delivery of effective technology cooperation which involves the transfer of skills and knowledge and just not the hardware. While it is apparent that the free market is the main driving force for the efficient introduction and assimilation of technology, successful long term technology cooperation requires that all parties must gain from the cooperation, while, at the same time, the protection of patents and intellectual property rights of the developer is essential.
4. **Industry and Freshwater:** Industry is not the main user of freshwater but it has the know how to manage this resource. It has already begun to manage industrial

water. It can, in the future, raise awareness within business communities and agricultural sector to take action.

Fig.5.4: Some innovative initiatives of industry

The rapid globalisation, initiated in part by advances in communication technology, has facilitated the integration of national systems of production and finance, resulting in the growth of cross-border flows of goods, services and capital. The United Nations Environment Programme (UNEP), as a contribution to the World Summit on Sustainable Development (WSSD), organised workshops in different continents that facilitated global and regional industry sector reports. These generated some recommendations on the role of industry in sustainable development for the continents as follows:

Africa

1. Promotion of industrial development on a sustainable basis remains a high priority area to alleviate poverty.

2. Increased investment in industry and the resultant increase in employment and wealth are necessary to improve capacity building and the environment.

Asia and Pacific

1. Small and medium enterprises play a decisive role in the region. They need to be involved more directly.

2. Unequal opportunities for men and women, violation of basic labour rights etc. are counteracting sustainable development. Stringent enforcement of relevant legislation and transparency of operating conditions are needed to address these issues.

Europe and North America

1. Industry desires clear and consistent targets in the effort to advance sustainability.

2. New business models are needed for promoting sustainable development, in particular those that introduce cleaner technologies, products and practices, implement new work and employment systems and create effective partnership structures.

Latin America and the Caribbean

1. Innovative financing for sustainable development needs to be done.

2. Internal markets promoting manufacture of value added products need to be developed.

3. Modernisation and expansion is needed to compete in the international market.

West Asia

1. The region must develop more small scale new industries to counter the dominance of the established large scale industries.

2. With the increase of private sector development and the shrinking of government bureaucracy, the private sector must not form monopolies or cause shortages that deprive people of their essential needs.

5.3.3 Service

The economic and industrial changes that have resulted from technological advances in agriculture and industry have led to the development of a complex, integrated system, which includes:

a) more producers and capital investment;

b) an extensive supply and service sector, which provides inputs to producers and consumers;

c) a major processing, transportation, and distribution sector, which moves an enormous range of products from the site of production to consumers in both national and international markets; and

d) extensive government participation in the form of regulatory activities, taxation and expenditure policies, commercial initiatives, research, market development, and involvement in matters of international trade and commerce.

With the emergence of globalisation, the service sector is growing to cater to the demands of both the producers as well as the consumers.

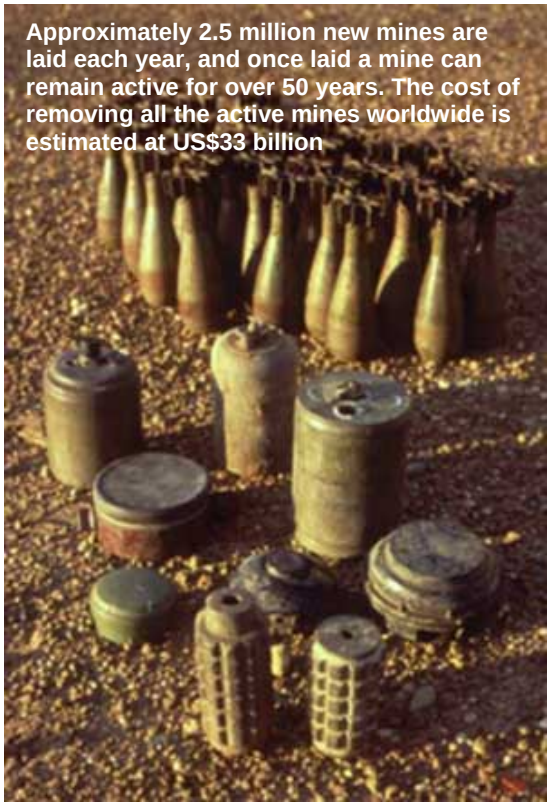
Fig.5.5: An extensive supply and service sector caters to the demands of producers and consumers today

Institutional reforms are required in national agricultural and industrial research and extension systems in many developing countries, so as to make them demand-driven and responsive. This requires access to databases of best practices for technology generation and dissemination. Application of new information and communication technologies can also help make extension services responsive. Where appropriate, extension services should be decentralised with appropriate combination of economic and social entrepreneurship with government role to assure adequate attention to sustainability concerns.

5.4 DEFENCE AND ARMAMENT

Many corporations were born out of the wars and today a strong relationship between military expansion and companies remains. While globally, military expenditure accounts for 3% of Gross National Product (GNP) compared with social development expenditure of 10% for health and education, in some countries, military expenditure

even exceeds social spending. There is particular concern about the sale of arms to oppressive or aggressive regimes, or into areas of potential instability. There is also particular concern about certain types of weapons: landmines and nuclear/chemical/biological weapons.



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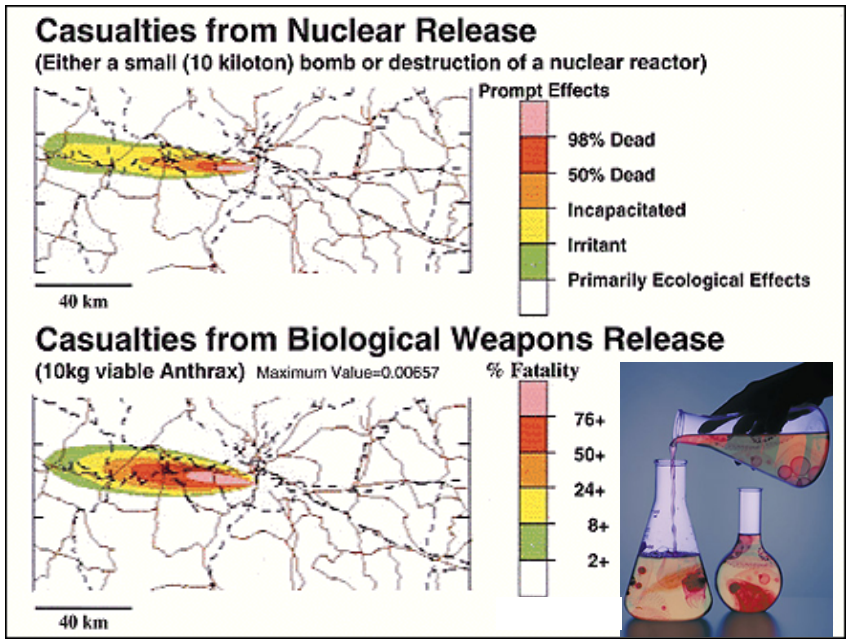

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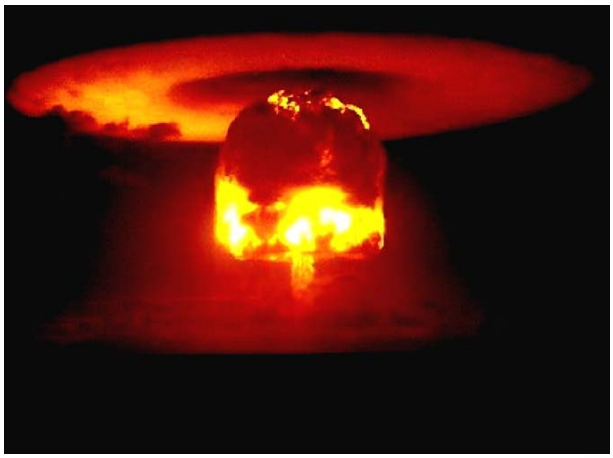

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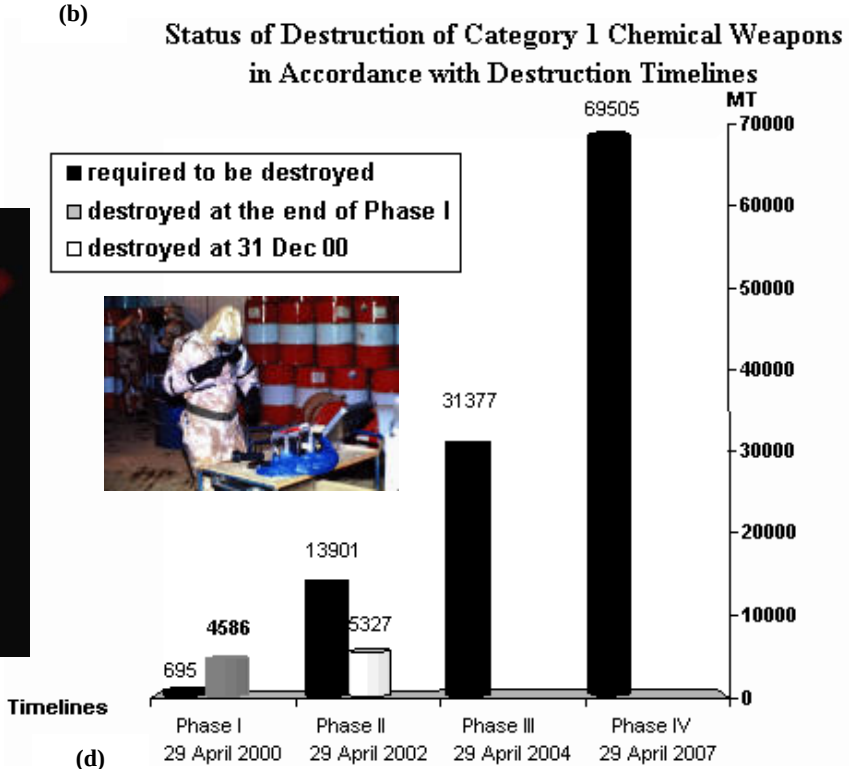

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Fig.5.6: There is a worldwide concern about a) landmines; b) biological (source: www.cdc.gov/ncidod); c) nuclear and d) chemical weapons (source: www.opcw.org/images)

Such weapons cause substantial civilian casualties, can linger for many years, and risk escalation and uncontrollable damage. For many groups, companies involved in the manufacture of these types of weapons are particularly unacceptable.

Contemporary war economies are characterised in part by the legal but more often illicit or informal exploitation of abundant valuable natural resources, including but not limited to oil, diamonds, timber, and columbite-tantalite ore (Coltan). Coltan is used in the fabrication of mobile telephones, laptop computers and other high-tech products. Proceeds from these 'conflict commodities' have provided significant financing for the parties involved in wars, and are pointed to as one of the contributing factors in the continuation or risk of renewed outbreak of these conflicts

Natural resource endowment alone does not necessarily mean that a country is at risk of civil war. However, when combined with other factors such as poor governance, extreme income inequalities, economic and social exclusion, declining growth rates, ethnic tensions, etc., they are more likely to become a source of tension as competing groups attempt to control access to them. A World Bank study has revealed that the risk of civil war is four times higher for natural resource-dependent states than for countries having no primary resource commodities. Also while resources can prove a boon for economic expansion, in developing countries they have more often been with little or no positive effects on the local economy. For example, it is worth noting that twelve of the world's 25 most mineral-dependent states and six of the world's most oil-dependent states are classified by the World Bank as highly indebted poor countries with amongst the world's worst Human Development Indicators.

Several explanations have been offered for the emergence of new tensions and wars. The most common is that with the abrupt retraction of superpower patronage in the early 1990s, governments and guerrilla groups alike were left to their own devices to finance their military campaigns in what had become extensions of the proxy wars that characterised the Cold War.

Warfare and conflict divert resources away from development. The two World Wars have shown us that war destroys the whole economies of nations. Large armies and armaments industries increase the risk of conflict, and the temptation to use such forces, either directly or as a threat, for example by terrorists results in diversion of expenditure from social spending into unproductive military and arms trade. This is of grave concern to the progress of sustainable development.

SAQ 3

What is the share of defence expenditure in your country's budget compared to other sectors of developmental spending? In your opinion, how should the social priorities be reoriented to accommodate the goals of sustainable development?

5.5 QUEST FOR COMFORT

Quest for comfort manifests itself in many forms. Some examples are:

- The quest for a reliable and plentiful food supply.
- The quest for abundant, clean, safe water.
- The quest for cheap and abundant energy.
- The quest to reach the stars (solid fuel).
- The quest on demand.
- The quest to cure disease.
- The quest for flexible and versatile materials.

Within these quests one can discern micro quests, e.g., the emerging quests for designer molecules, molecular level fabrication, designer genes (lab-on-a-chip, nanotechnology, genomics); and macro quest for a sustainable future (environmental protection, pollution prevention, greenhouse gas reduction, sustainable development).

In pursuing these quests we take on a variety of challenging roles – those of the dreamer, visionary, inventor, builder, entrepreneur, manager, policymaker etc. We discharge our roles following a particular life-style that may or may not be compatible with sustainable development.

Fig.5.7: The quest for comfort manifests in many forms

5.5.1 Life Style and Consumerism

The problems of consumerism and lifestyle in a market economy have long been neglected. The price of consumerism is a core problem in sustainable development, because it concerns the consumption of natural resources converted into products and due to non-biodegradability of waste. In a market economy, consumerism is based merely on the assumption that the market will grow as consumption increases. Consideration of the meaning, value and impact on environment of consumerism, however, is not possible in terms of the market economy. It is only from the perspectives of political and ecological economy that the problems of consumerism will surface. If the practice of consumerism remains unchanged, economic globalisation will simply cause the ecological environment to deteriorate further. High levels of consumption are certainly the first and foremost killers of our natural habitat.

Humanity's concept of well-being derives from the urge to fulfil desires that are to a considerable extent, determined by the values of society as a whole. In a market-oriented economy, such desires are generated by forces that push the expansion of market leaving little space to reflect upon other desires. People's confidence in consumerism becomes an important factor in economic expansion. If we wish to transform society by simply changing degree of consumption but not people's desire for gratification, talk of sustainable development will remain as an empty talk.

Why can we not slow down and ask ourselves whether the present day styles of consumption are really what we want? Because we are being indoctrinated to chasing

higher and higher levels of consumption, facing the problems of consumerism is far more difficult than we can imagine. Should we not seriously consider a simpler lifestyle? Are we not being brainwashed and misled to believe that economies must grow relentlessly? Does the concept of economic recession not imply some specific, subjective value and a materialistic mode of consumption? Do we have no choice? These are some of the questions connected with 'life-style'.

Sustainable lifestyle: The answer to the question 'What is a sustainable lifestyle?' has to be worked out by different communities or families in their respective cultures. It will be different in detail for everyone - though we could suggest some basic guidelines. What follows is no more than a rough framework for more sustainable and ethical living: it can and should be locally customised, through your own reflection and wherever you are.

1. Eat thoughtfully

Eating fresh produce, less meat and avoiding processed foods is now coming in vogue in the rich countries as a sign of good living. For once it might be worth following fashion, though not for fashion's sake. When choosing food, try asking yourself these six questions:

1) Does the production of this food cause the unnecessary suffering of animals?
2) Or cause the unnecessary suffering of other humans?
3) Where does the food come from? A farm nearby? The closer to home the better.
4) How was the food produced?
5) Have pesticides and insecticides been used in its production?
6) Is the food likely to contain genetically modified organisms (GMOs) like Monsanto's Roundup Ready soybeans?

In prioritising the money spent on food, poor people have little option. But the better-off spend large proportion of their income on leisure: tobacco, alcohol, travel. Why do we not spend more on *good food*?, that is, food produced by sustainable farming systems such as organic growing. Eating good, fresh, uncontaminated, wholesome food is one of the best things we can do to keep healthy and vigorous and support sustainable development.

2. Shop thoughtfully

- Shopping locally - on foot or bike - has health benefits, since few of us take sufficient exercise.
- Check the labels. Insist as proper labelling on packaged food. We need honest labelling (Eco-labels) to help us choose wisely. How can we consumers make ethical and sustainable choices for the products we buy if we cannot find out how they are produced?
- Buy manufactured goods thoughtfully. Ask/find out (e.g. from consumer magazines which now include environmental information in many cases) about a manufactured product before you buy it. Ask yourself if you *need* it or just *want* it?

3. Bank thoughtfully

- Invest ethically and use an ethically sound bank for your money: By placing your money with ethical banks or investment groups, you can be sure that your money is used in a way that supports sustainable industry and development. If you actively wish to use your money to help the needy, you can place it with groups who then lend it to small co-operative ventures in impoverished communities. You can choose whether to accept interest on your investment or not.

4. Vote thoughtfully

- Use your political power wisely. Press your government, local and national, to a tax system to reward sustainability. Some tax systems are lumbering slowly towards taxing resources, not people. This has the benefit of making it less expensive for companies to employ people, and can mean more employment. But we need big changes and we need them soon - for example, to encourage a sustainable transport system, we need to change taxes on cars to penalise those who use cars exclusively and excessively to encourage car-pooling.

5. Use natural resources thoughtfully

- With an eye to the future ponder if anything will be left for your grandchildren or for their children? Does what you consume cause pollution, either directly or indirectly, climate change and depletion of useful?
- Get enthusiastic about renewable energy. Install or build your own solar heating. Many cheap and simple designs are available for this and many other sustainable technologies. With technologies available now, more and more of all our energy needs could be met in a sustainable manner. The problem is that our whole industrial and economic infrastructure is geared to maintaining the status quo of centralised power stations and fossil-fuelled transportation. Yet there is vast potential here for new industry to exploit the power of the sun either directly (solar heating, photovoltaics) or indirectly (wind, waves, tide, bio-gas, fast-growing wood). Encourage your government - national or local - to offer support for schemes that improve energy efficiency. Do not wait for someone else to do it or nothing will happen.

6. Dialogue thoughtfully

- Ease the process forward by listening to others as well as giving your own opinions when talking with friends, neighbours, local groups, politicians, business-people, religious groups - to ease the process forward. We, the people, have to get involved. Getting involved is very empowering.
- Know the issues. Seek to persuade by making practical sense.
- Start a forum for local ideas which also helps to rebuild a sense of community.

5.5.2 Energy

The world's oil reserves are estimated to be 1 trillion barrels. At the present rate of consumption, it is estimated that these reserves will be exhausted in about 45 years. The recent international efforts assessing the environment, including the 1992 Earth Summit in Rio de Janeiro, the Integrated Pollution Prevention and Control (IPPC), the United Nations Framework Convention on Climate Change (UNFCCC) and the various sessions of the Commission for Sustainable Development (CSD), refer to the massive consumption of oil and other fossil fuels as aggravating global environmental problems, such as acid rain and the 'green house' effect. The Kyoto Protocol, recently adopted in the context of the Climate Change Convention, calls for a decrease in carbon dioxide (CO_2) emissions and this is possible only when energy efficiency and renewable energy sources are promoted with determination.

Modern agriculture is heavily dependent on non-renewable energy sources, especially petroleum derived fertilisers and irrigation pumps. The continued use of these energy sources cannot be sustained indefinitely; yet to abruptly abandon our reliance on them would not be economically feasible. A sudden cut-off in energy supply would be disruptive. In sustainable agricultural systems, there is reduced reliance on non-renewable energy sources and a substitution of renewable sources to the extent that is economically feasible.

From an energy perspective, agriculture has a double role: it is an energy user and an energy producer. All stages of the food chain require one form of energy or another, and renewable energies such as biomass, solar and wind, could make an important contribution to its sustainability and productivity, through technologies useful in irrigation, mechanisation, processing, conservation, transport, etc.

The economic use and promotion of renewable energy sources is vital to ensure food security for future generations, as farmers in the future may increasingly be faced with the difficult task of the need to produce higher quantity and quality of food. In industrialised countries there is already a trend to move towards agriculture with less fossil sources in terms of direct (electricity, fuels) and indirect (fertilisers, pesticides) energy inputs. In developing countries, where agriculture is still largely energy-starved, the required increase in energy intensity will depend on the availability of energy resources and on the price and other policies related to their utilisation. In all countries, renewable energies will undoubtedly play an increasing role in agriculture production. Moreover, agriculture could become a major energy producer.

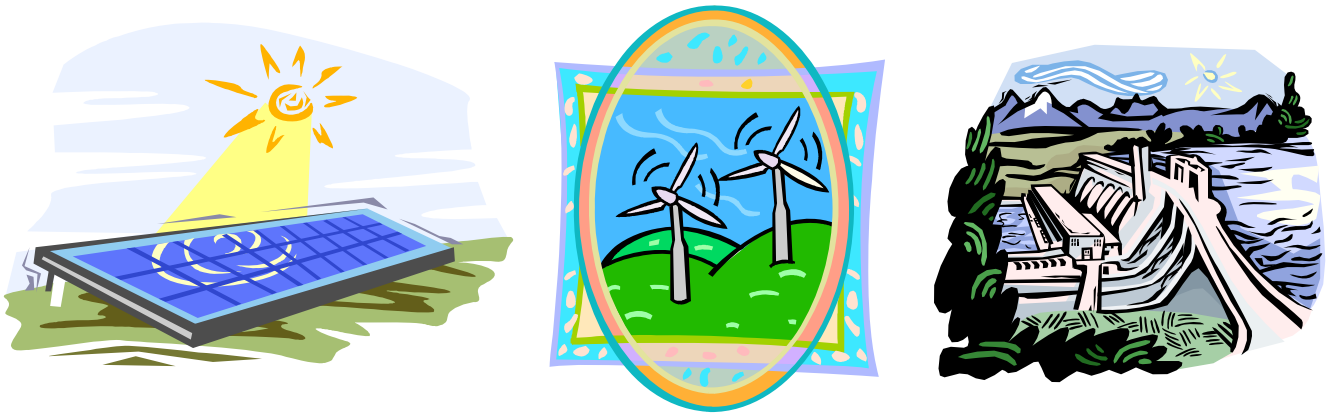

Fig.5.8: Let us save energy and promote the use of renewable energy around us

The conversion of large amounts of agricultural residues into energy, taking into account that a minimum quantity must be left on site to recycle nutrients, can contribute considerably to national energy balances. The potential of combined production of sugar and electricity to be fed to the grid is very significant. Purposely grown biomass for energy has high potential, especially in the context of land set-aside, land rehabilitation, and reforestation programmes, always taking care that this form of energy production does not enter in competition for land for food production, which must take precedence. Energy for and from agriculture is a topic which requires increasing attention from policy makers and scientists as a key element of national and global responses to the need for fossil fuel substitution, enhancing environmental awareness, achieving emission targets and, more importantly, eliminating poverty and hunger from the rural areas of many developing countries.

5.6 SUMMARY

- The available natural resources in a country determine its socio-economic strength. Technological know how and economic determinism enhance the resource use capability of the country for development. A balance between environmental constraints and economic policies is required for sustainable development.

- The measure of sustainability of a country is indicated by parameters of sustainable development. Towards achieving this, stewardship of both natural and human resources is of prime importance. A major goal of sustainable agriculture is to provide food and fibre for the world's growing population while minimising resource inputs, improving land management practices, protecting natural ecosystems, and improving human health and socio-economic equity. Achieving sustainable agriculture may require radical changes in many areas and in the

future, may lie at the crossroads of modern, intensive, technological agriculture and more traditional, environmentally benign farming methods.

- Industry is a powerful social institution and thus is a major player in determining the kind of world in which we live. Achieving sustainability will require that sustainable practices become a dominant management theme and an accepted or even expected way of doing business throughout the corporate world, both in industry and agriculture.
- Systemic changes are needed if we are to solve these problems. Some of the other imperatives are as follows:
  - Promote awareness and build capacity at the community level to manage resources that support the livelihoods of the poor and the rural communities.
  - Provide incentives for better management and use of natural resources to improve local livelihood and national economy.
  - Build broad-based constituencies and partnerships at community level for sustainable change and development and promote knowledge networks.
  - Effective governance structures are needed to monitor and ensure sustainable and equitable management and use of natural resources. Clear roles need to be defined for institutions, communities and individuals.

5.7 TERMINAL QUESTIONS

1. What are the socio-economic, political and ethical issues to be taken into consideration for natural resources conservation and management?
2. Who controls the management of natural resources and under what criteria are they deemed to be a success?
3. How can you support natural resources conservation?
4. What is sustainable agriculture? Summarise the potential advantages of new agriculture technologies and the major concerns. Are new technologies the solution to the world's food security in the 21st century?
5. Discuss the various parameters to be considered for assessing sustainable development.

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