UNIT 14 NEW AND EMERGING AGRICULTURAL PRACTICES

Structure

14.0 OBJECTIVES

After reading this unit, you will be able to:

- define the term 'agricultural practices' from a holistic perspective;
- discuss the production related practices under its broad constituents;
- explain how concerns of sustainability practices have been duly incorporated into the agricultural practices pursued;
- describe how water use efficiency practices have occupied a place of centre stage in the agricultural practices pursued;

- explain how conservation and post-harvest management practices have contributed to the progress of agricultural development in India; and
- specify some of the new agricultural practices adopted in India.

14.1 INTRODUCTION

It is clear from the earlier units that the Indian agriculture has undergone a great deal of change in terms of agrarian structure, institutional arrangements, technological practices and agricultural production and productivity. Beginning with serious deficiency in food grains production at the time of independence, agricultural production has achieved a great turn around by 1980s with self-sufficiency in food grains production. We have seen the role played by green revolution (GR) in this transformation process. We have also observed that GR which helped to overcome the food problem, brought in its wake several adverse effects like erosion of soil fertility due to excessive use of chemical fertilizers, growing regional disparities due to neglect of dry regions, and growing distress among small-marginal farmers due to high risks without commensurate support systems. A combination of these factors have left the gains of GR a thing of the past, leaving Indian agriculture and the small-marginal farmers in a crisis situation.

At present, Indian agriculture is faced with the challenge of reviving and sustaining agricultural productivity with fair distribution of gains across the regions and across all classes of farmers. In this context, there have been a number of initiatives taken towards adopting new practices in agriculture. These practices are also linked to combating the major challenges faced by Indian agriculture viz. (i) increasing production and productivity of crops by an efficient utilisation of critical inputs, (ii) ensuring sustainability of production systems by practising scientific conservation practices, and (iii) linking production to the market and the changing consumer preferences. Against this background, the present unit focuses on discussing the various agricultural practices pursued in India. The discussion is presented under the following four broad groups of practices: (i) production related practices; (ii) sustainability related practices; (iii) water use efficiency practices; and (iv) conservation and post-harvest management practices.

14.2 PRODUCTION RELATED PRACTICES

Production related practices can be discussed with reference to certain principle components of agricultural resource use. These can be clubbed under: soil, fertilisers, additional nutrients and changes in cropping practices.

14.2.1 Soil Fertility/Health

Soil is a natural resource formed and conditioned by several factors like: (i) climate (temperature and rainfall), (ii) topography of the area, (iii) living organisms like vegetation, (iv) nature of parent material (like type of rocks and minerals), and (v) time. It is thus both a physical as well as a chemical process. During this process, many organic and mineral matter is added, lost and transformed. The importance of soils lies in the fact that it provides a basic medium for the growth of crops. In fact, the type and profile of the soil determines what crops can be cultivated in it. A soil's potential for producing crops is largely determined by its capacity to store water and its other attributes (like acidity, depth, and density) which together determine how well the roots of crops can develop. Changes in these soil attributes directly affect the health of the plant. Further, over time with the continuous cultivation of crops, the capacity of soils to provide the required nutrients diminish. As plants grow, their living cells take up chemical substances from their environment and use them as a source of energy depleting the environment, especially of the quality of soil. This necessitates the use of practices that can help restore or replenish the major nutrients in soils to sustain good plant growth. Simultaneously, many natural factors and anthropogenic factors, including improper practices followed during cultivation, result in degradation of soils making them unfit for cultivation. Thus, management of soils through practices which help to restore soil fertility and health are critical requirements for sustaining the productivity levels of agricultural produce.

14.2.2 Fertilisers

A fertiliser is any natural or synthetic substance which when spread or worked into the soil increases its capacity to support plant growth. Such substances may be: (i) organic materials or (ii) chemical (inorganic) fertilisers. The application of fertilisers is an important and necessary practice both for restoring soil fertility as also provide the stimulus required for higher agricultural growth.

Organic Materials

Before the development of chemical or synthetic fertilisers, organic sources in various forms were used to enhance the soil fertility and improve its physical properties, such as water holding capacity, important for plant growth. Organic fertilisers are natural materials of plant or animal including livestock manure, green manures, crop residues, household waste and compost. Such materials are used as fertilisers either directly or after they are cycled as animal or human food. Today organic substances are used in conjunction with chemical fertilisers to supplement the availability of the latter. The different types of organic manures that are used as fertilisers include: (i) bulky organic manures, (ii) concentrated organic manures, and (iii) bio-fertilisers.

Bulky organic manures include farm yard manure (FYM), compost and green manure. These are added in large quantities to the soil which helps to improve the physical condition of soils. They enhance the activity of micro-organisms in soils by: (a) improving the water-holding capacity of soils; (b) reducing evaporation losses; (c) controlling soil temperature; (d) and providing almost all the nutrients required for the plant growth. Exclusive farm yard manure is mainly cattle dung generally available in villages and easy to apply. However, it is also used as a source of fuel by the farm households and hence FYM is not totally available for use as fertiliser. The amount of nutrients provided by FYM depends upon its quality which is governed by the feed provided to cattle. This means that the quality of FYM in terms of its nutrient contents can be improved by feeding cattle with concentrated feeds (like cotton seed cake, linseed cake, soy meal, wheat bran, legumes, hays and grains). Other types of organic manures are rural and urban compost, sewage material and sludge. *Compost* is obtained by the decomposition of wastes from farmhouses, cattle sheds, town refuse and night soil. Sludge is another thick, soft matter settled as sediments at the bottom of sewage storage tanks which also contain large quantities of plant nutrients. However, these materials must be properly treated as they can otherwise damage soils. Another recent practice followed by farmers is vermi-composting. This is a process by which farm residues or forest litter are used to produce compost by introducing earthworms into the pit in which the residues or litter are stocked. Preparation method is relatively simple and the compost produced contains important elements like carbon, nitrogen and phosphorous. Green manuring has been practiced by farmers in India for long. It involves the ploughing into soil of green plant tissue for improving the physical condition of the soil and also to increase its fertility. Generally the crops selected to be grown for green manuring are those that have a profuse growth of leaves and grow rapidly during the early stages of their life cycle. They are also capable of growing well in poor soils, and have a deep root system. Fertilizing soils through the process of green manuring is more economical than using other types of fertilisers. Certain green manure plants like beans, peas or radishes provide edible substances also. Moreover, during the growth process, these plants prevent erosion of top soil and their deep roots help to break up the hard pan. Farmers incorporate green manure crops in their crop rotations to augment soil fertility. The practice is especially recommended for Gangetic Plains where the rice–wheat systems of production prevail and the productivity of soil is declining.

Concentrated organic manures include oil cakes. Oil cake is the solid residue that remains after some oil containing seeds are pressed and the oil is extracted from them. They are used as cattle feed or as fertiliser depending upon whether they are edible or non-edible. The edible oil cakes are drawn from cotton seed, groundnut, linseed, soybean meal, rapeseed, sesame and coconut. The non-edible oilcakes are cakes derived from the non-edible oilseed crops like castor, neem, safflower, *karanj,* and mahua.

Bio-fertilisers are artificially multiplied cultures of certain soil organisms that can improve soil fertility and crop productivity. They are preparations that have living cells of efficient strains of micro-organisms as active ingredients. These microorganisms have a symbiotic relationship with the plants and help them to take up nutrients. Bio-fertilisers accelerate certain microbial processes in the soil which augment the extent of availability of nutrients in a form easily assimilated by plants.

Chemical/Mineral Fertilisers

Traditionally, farmers have used organic fertilisers (chiefly farm yard manure) to replenish soil fertility. However, the amount of nutrients added to the soil by organic substances are small and the decomposition of organic manure is often a slow process. A better option is the use of chemical or synthetic fertilisers, called inorganic fertilisers. The high yielding varieties resulting from the genetic improvement of plants are highly responsive to chemical fertilisers. This means that their yield potential can be realised only if the right amount and type of fertiliser is provided as crucially required inputs. With a change in cropping systems from monoculture to cultivating two or more crops in a year (made possible by the short duration varieties developed), chemical fertilisers have come to be used extensively.

Chemical fertilisers contain one or more plant nutrients that is easily soluble in water and thus become quickly available to the plants. These are required to be applied in specific doses for different crops determined through scientific research. In addition to the dose, the time and mode of application is also important. The application of this practice resulted in higher productivity of crops under the 'green revolution' methods. The main nutrient supplied through chemical fertilisers are nitrogen (urea, for example, is a nitrogenous fertiliser which is the main chemical required for plant growth), phosphorous and potassium (i.e. NPK). These are the macro-nutrients required for plant growth and survival.

Mineral fertilizers are another form of chemical fertilisers which need to be applied to crops at least twice in a growing season either basally at the planting stage or top-dressed during the stage of vegetative growth. The amount of inorganic fertilizer used in most smallholder farming systems fall far below the standards recommended due to reasons of: (i) poor purchasing power of small farmers, (ii) risk aversion (of higher investment) due to fear of poor and unreliable rainfall, and (iii) insignificant returns owing to unpredictable market factors. However, when available, fertilizer use being not overly labour intensive, allows time for other performing tasks (thereby earning income elsewhere).

14.2.3 Achievement of Synergetic Effect

The use of both organic and inorganic fertilisers is important for stimulating agricultural production. Integrated nutrient supply and management involve the efficient and judicious supply/use of all important nutrients required by the plants/ crops in a balanced manner. It involves the use of chemical or mineral fertilisers in conjunction with organic and biological nutrients to improve or maintain soil productivity. Chemical fertilisers are a concentrated source of nutrients that are absorbed by plants quickly. Organic manures, on the other hand, provide relatively less nutrients but help to improve the physical properties of the soil in a way that is conducive for plant growth. Green manures such as after-harvest-crop-residues augment the supply of nitrogen in addition to improving the soil health and quality. The synergistic effect of the combined use of nutrients with organic farming practices helps in improving the soil's chemical, physical and biological properties. This leads to increased crop productivity.

14.2.4 Calibrated Cropping Practices

Over time, farmers have learnt from experience that the cultivation of the same crop repeatedly on the same land leads to a reduction in the yield of the crop. An alternative practice adopted to overcome this situation is 'crop rotation'. Crop rotation involves the cultivation of different crops in a sequence in which the green manures like the residuals of other crops serve as organic manure. In India, there are three agricultural seasons implying that some crop or the other can be grown all round the year. The three seasons are the rainy or *kharif* season from July to October, the winter or *rabi* season from October to March and *zaid* which extends from April to June. During these seasons, crops may be grown as sole crops or mixed crops (i.e. mixed cropping). When only one crop is grown in a season it is called mono-cropping and if two crops are grown it is called a double cropping system. Rotational cropping is the cultivation of two or more crops in a definite sequence and when more than two crops are taken in a year from a given piece of land it is called multiple cropping. The kind of cropping system that is found in a region is the cumulative result of farmers' experience, personal preferences and skills, government policies, resource availability, response to pests and diseases prevalent in an area, ecological suitability and feasibility, climatic conditions, socio-economic factors, and market demand conditions. Based on the agronomic diversity, the country has been divided into a number of agricultural regions where different cropping systems are predominant.

14.2.5 Sequential Multiple Cropping

The practice of sequential multiple cropping involves the cultivation of short duration crop varieties with intensive input management. This is practiced mainly in irrigated regions and helps to increase land use efficiency. In adopting a particular crop rotation system, a major consideration is the economic return per unit of land. However, profitability of a particular system depends significantly on the input costs and output prices and hence in a country like India it is vulnerable to changes in government policies. Some examples of crop rotations being followed in India are the rice-wheat-cowpea in Orissa, rice-french-bean-groundnut and groundnut-chickpea in Maharashtra, rice-potato-green gram in western parts of Uttar Pradesh, and rice-cabbage-potato and rice-radish-pea-french bean in north-western mid-Himalayas.

Check Your Progress 1 [answer in about 50 words in the space given]

1) Mention the three major challenges around which the various agricultural practices have evolved?

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2) Into which two groups are fertilisers classified? Which of this refer to natural materials of plant and animal? Why is it not efficient to depend only on such natural fertiliser?

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3) What are the three major factors that inhibit the small farmers in India from using the chemical fertilisers in adequate quantity/measure?

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4) Why is 'sequential multiple cropping' not practiced widely in India? In which regions can it be practiced to increase land use efficiency?

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14.3 SUSTAINABILITY RELATED PRACTICES

Sustainable agricultural practices rest on the principle that we must meet the needs of the present without compromising the ability of future generations to meet their needs. It is defined as pursuing those agricultural practices which, over the long term: (i) enhance the environmental quality and the resource base on which agriculture depends; (ii) provide for basic human food and fibre needs without compromising on environmental quality; (iii) ensure economic viability in terms of input costs involved and the returns realised; and (iv) improve the quality of life of farmers and the society as a whole. In this, the efficient management of both the *human and natural resources* is of prime importance. Management of human resources include consideration of social responsibilities such as: (i) improving the working and living conditions of agricultural labourers, (ii) meeting the needs of rural communities, and (iii) ensuring the consumer health and safety of both the present and the future generations. The management of natural resources, on the other hand, involve maintaining or enhancing the vital resource base for the long term needs. In this section, we shall briefly discuss the practices followed in the management of natural resources like land and water.

14.3.1 Land Degradation and Soil Erosion

Land degradation is a combination of several processes that result in the reduction or loss of the biological or economic productivity of agricultural lands. The processes resulting in degradation of land include soil erosion (caused by wind and/or water), deterioration of the physical, chemical and biological properties of soil and long-term loss of natural vegetation. Erosion of the soil is a major cause of degradation resulting in the loss of top soil and formation of channels and gullies.

Soil erosion continues to be a serious threat to our continued ability to produce adequate food. Numerous practices have been developed to keep soil in place. These include reducing or eliminating tillage, managing irrigation to reduce runoff, and keeping the soil covered with plants or mulch. Enhancement of soil quality can be achieved by the integrated use of nutrients as outlined below.

14.3.2 Integrated Use of Nutrients

The sustainable use of chemical fertilisers involves the use of the right kind of fertiliser based on soil tests which help in identifying the magnitude of specific nutrient deficiency. Soil can be tested for their phosphorous and macro/micro nutrient deficiency at laboratories. Facilities for this are established at agricultural universities, research institutions and mini soil testing laboratories set up at block level. Further, the major nutrient levels (like those of NPK) can also be assessed on the farm itself using mini soil test kits.

Besides the application of the appropriate quantity of a fertiliser based on soil test and plant requirements, the integrated use of both organic and chemical fertilisers in modulated conjunction is a practice that is used not only for stimulating agricultural production but also for ensuring sustainable use of land resources. Integrated nutrient management involve the efficient and judicious supply/use of all important nutrients required by the plants/crops in a balanced manner. This helps to restore and improve the chemical and physical properties of soils.

14.3.3 Irrigation Scheduling

Besides crop specific water requirements, water requirements also vary across different stages of the growth cycle of the plant. Local climatic and soil conditions also influence water availability to crops. Non-availability of water at critical stages of plant growth can hamper flowering and grain development. Likewise, provision of excess water can also be counterproductive as crops cannot utilize excess water and may become stressed from reduced oxygen levels of saturated soils. To counter these effects, 'irrigation scheduling' is a practice followed. This helps in minimising instances where too little or too much water is applied to crops. Proper irrigation scheduling by growers involve fine-tuning of the time and amount of water applied to crops. This is based on factors like: the water content in the crop root zone, the amount of water consumed by the crop since it was last irrigated and during the crop development stage, etc.

14.4 WATER USE EFFICIENCY PRACTICES

Agriculture is a major consumer of water and the availability of fresh water is gradually declining. The intense pressures on our water resources due to the growing demand from agriculture, domestic and industrial sectors are forcing us to look at irrigation not only from the point of view of optimising water management to meet the plant water requirements but also for the more generic issues of enhancing water use efficiency. This basically involves improving the water availability for the plant and minimising water losses during irrigation. From the sustainability angle, the emerging practices include the use of alternative methods of irrigation such as drip and sprinkler irrigation. Through these methods, water losses through evaporation are significantly reduced and water availability for the plant is enhanced.

In the above context, 'water use efficiency' is defined as the yield per unit area and per unit of water used. The water requirement of different crops/varieties differ. For instance, rice requires much more water to produce a unit of dry grain than wheat implying that the water use efficiency of rice measured in kg/ha-cm is significantly lower than that of wheat. Within the same crop, different varieties also have different water requirements and use efficiency. Thus the selection of proper crops and varieties that are better adapted to available water in the growing region is a simple practice that helps to improve water use efficiency. Besides this practice of employing appropriate choice of crop variety, some innovative practices evolved for higher level of water use efficiency are the following.

14.4.1 Conjunctive/Multiple Use of Water

The conjunctive use of water is an irrigation management technique that helps to enhance the productivity and profitability of irrigated agriculture. It involves coordinated use of total water from multiple sources such as rivers, canals and ground water. Coordinated use of water from different sources helps to optimise total water use and ensure water availability for the entire period of crop production/ year. The advantages of conjunctive use of water are to: (i) mitigate shortages of canal or ground water, (ii) increase dependability of existing water supplies, (iii) alleviate the problem of high water tables and salinity on account of canal irrigation, and (iv) facilitate the use of saline ground water through dilution.

Water can be put to number of end uses which may be independent of the intended use of that water. For instance, a community or individual farmer's pond which stores water for irrigation purposes, can also be used to breed fish which is a high value commodity. This leads to an improvement in the economic productivity of water.

14.4.2 Alternative Irrigation Methods

There are three main irrigation methods. These are: (i) surface (or gravity) irrigation, (ii) sprinkler irrigation and (iii) drip irrigation. Surface irrigation is the conventional method of irrigating crops which is still widely used. In this, water is applied to the crop by flooding it on the soil surface, mostly by gravity flow. This is however an inefficient method of irrigation where considerable wastage of water occurs making the overall efficiency level low due to problems of water-logging and salinisation which commonly result. When the entire field is flooded, it is called basin irrigation. Significant water losses of this method led to the development of modified surface irrigation methods such as: (i) the furrow irrigation method and (ii) check basin method. In the *furrow irrigation* method, furrows are designed along the longitudinal slope of the land and water is fed into small channels or strips. Water movements through these furrows, both along the longitudinal slope and laterally, increases the efficiency of water usage. The *check basin* method of irrigation is suitable for level plots. In this, water is run into the plot surrounded by small ridges. The plot is then irrigated by main and lateral channels. The main channel is aligned along the upper end of the field and checks are made on either side of the lateral channels. Both these methods attempt to achieve higher efficiency of irrigation through a control over the speed of water flow and thereby minimising water losses.

The sprinkler irrigation system imitate natural rainfall. In this, water is pumped through pipes and then sprayed onto the crops through rotating sprinkler heads. These systems are more efficient than surface irrigation as they provide water uniformly, reduce run-off and minimise deep percolation losses. However, they are expensive to install and operate besides needing pressurized water supply. Conventional sprinkler systems spray the water into the air losing considerable amounts to evaporation. Low energy precision application (LEPA) offers a more efficient alternative. In this system, the water is delivered to the crops from drop tubes that extend from the sprinkler's arm. When applied together with other appropriate water-saving farming techniques, LEPA can achieve efficiencies as high as 95 percent. Further, since this method operates at low pressure, it also saves as much as 20 to 50 percent in energy costs compared with conventional systems.

Drip irrigation method is the most efficient irrigation method as it employs low-flow technology and deliver water precisely and directly to plant roots at rates that prevent deep percolation and run-off losses. Water is delivered to the crops in slow continuous drops or in a trickle. Installation costs are high but advantages of water saving, enhanced plant growth and yield, and saving of labour and energy compensate the high installation costs significantly. The system also improves efficiency of fertiliser application and does not lead to soil erosion unlike in the case of other methods like surface/sprinkler irrigation. Research has shown that in sugarcane crop, drip irrigation has resulted in 35 percent higher yield, 50 percent saving in water and 50 percent saving in labour costs. Similar increases in yields and savings in water and labour are reported in other crops like banana and citrus from drip irrigation.

14.5 CONSERVATION AGRICULTURAL PRACTICES

Conservation agriculture is different from conventional agriculture in the sense that it does not aim at maximising yields by exploiting the soil and agro-ecosystem resources. Rather, it seeks to optimise yields (and profits), by achieving a balance of agricultural, economic and environmental benefits. Conservation agriculture, in addition to its contribution to sustainable agriculture and rural development, presents a powerful option for meeting the future food demands. This is achieved by adopting practices helpful in: (i) enhancing the efficiency of inputs, (ii) increase farm income, (iii) improve and sustain crop yields and (iv) protect and revitalize soil, biodiversity and the natural resource base. Conservation agriculture, therefore, addresses issues of crop production, natural resource base, bio-diversity, livelihood needs, etc. The practices followed pertain to three interlinked core principles of conservation agriculture viz. minimal soil disturbance, preservation of soil cover and diversification of crop rotation.

Reduced tillage or conservation tillage is a related practice which involves minimum soil disturbance by allowing crop residue (or stubble) to remain on the ground so that it could be incorporated into the soil. Such tillage practices may progress from reducing the number of times the soil is tilled to completely stopping tillage, a practice called zero tillage. The advantages of reduced or zero tillage are the prevention of wind and water soil erosion and retention of fertile top soil. This also results in increased population of earthworms which is helpful in improving soil fertility.

Mulching is another agronomic practice helpful in retaining soil moisture by reducing evaporation, facilitating infiltration of water into the soil, improve the soil structure, and prevent erosion of soil. It involves the covering of the ground around the plants with straw, grass, crop residues, compost or plastic sheeting to restrict evaporation and add organic matter. Live mulching is also practised by farmers in which a fast growing legume is established before or along with a widely spaced grain crop like maize and incorporated into soil at an appropriate time. Grass mulches applied in varying quantities per hectare in wheat and maize have been found to enhance yields by 8 to 58 percent over controlled cultivation.

Contour farming is another agronomic practice followed in hilly areas in which cultivation is done along contour lines rather than up and down the hills. In this, ploughing, seeding, planting and intercultural operations are performed along contour lines resulting in the formation of ridges and furrows. These act as mini barriers and reservoirs by intercepting rain water and reducing runoff of water, nutrient loss and soil erosion.

Incorporation of organic matter into the soil and practising crop rotations are essential components of conservation agriculture. They improve the capacity of soils to produce crops and limit wind and water erosion. However, limiting soil erosion and land degradation are not the only objectives of conservation practices. Their other objectives include: (i) crop-livestock integration in farming systems; (ii) increasing the biomass inputs to soil systems; (iii) optimizing the use of organic and inorganic nutrients; and (iv) practicing the ecosystem-based and integrated management methods to control weeds, pests and diseases. Integrated pest management (IPM) practices currently practised by farmers aim at keeping: (i) pest populations below harmful (called economic threshold) levels (instead of their complete eradication), (ii) protecting and conserving environment including biodiversity, and (iii) making plant protection feasible, safe and economical, even for small farmers. A major component of IPM is the use of biological agents which are natural enemies of the pests and hence limit their populations in the field.

14.6 DISTRIBUTIONAL PRACTICES

Distributional practices are post-harvest management practices. Agricultural commodities are produced for the market where they are purchased for consumption by the end-users or by processors who add value by converting them into processed products. Post-harvest practices and operations create form, time, place and possession utilities. This means making the product available to a consumer in the *form* in which he wants it, at a *time* he requires it and in a *place* where he can buy them. In view of this, depending upon the product, post-harvest practices range from simple practices like cleaning and grading to more complex practices like milling, processing, branding and packaging all of which would contribute to enhancing the shelf life of the commodities. In this section, we list some simple practices followed at the farm level which facilitate the distribution of the commodity in a desired state of quality to the consumers.

Cleaning, Standardization and Grading: Cleaning is a process by which impurities in the form of straw, husk, soil, stones, etc. are separated from the grain. At the farm level, this is done manually and involves sieving, washing and drying of the grains. Washing is very common in case of vegetables, and to a lesser extent in fruits, aimed at removing mud and soil. Standardization is the process of setting standards of product quality based on characteristics like weight, size, colour, appearance, texture, moisture content, staple size, foreign matter content, chemical content, ripeness, sweetness, taste, etc. This makes the product quality uniform for consumers and the process of marketing easier. Grading is the sorting of the produce into different lots according to quality standards of the product. Cleaning and grading practices may be undertaken at the producer's (farm) level or during subsequent stages of the marketing chain. For several products in India, grading is mandatory according to grades fixed by the government. A system of grading of agricultural products referred to as centralized grading system involves enforcement of product purity and quality standards through periodic checking at specified laboratories of the Directorate of Marketing and Inspection. Agricultural products that meet purity and quality standards are granted Agmark labels. Decentralised grading system is followed in case of commodities like fruits, vegetables, cereals, pulses and eggs which do not require elaborate testing arrangements and can be graded on the basis of physical appearance. The purpose of grading is to take advantage of price differentials attributable to differences in physical and purity characteristics of commodities.

Storage: Agricultural commodities are characterized by seasonality in supply but carry regular all year demand. However, their inter-year variability in production is high. Hence, storage is an essential activity that ensures maintenance of the product in its quality and quantity. Storage also facilitates the holding of the commodity by producers till the right price can be obtained in the market. Traditional structures and containers in which grains are stored in rural areas are made from locally available materials, differing in size, shape and capacity. Common structures and containers include gunny bags made of jute; earthen containers made of burnt clay of capacities ranging from half to three quintals, bamboo structures, straw structures (which are circular structures made from un-trampled paddy straw) and masonry structures. Traditional farm and household level storage practices involve the use of salt, ash, camphor, lime, and pongamia leaves. These are mixed with the commodity and placed in different types of structures/containers to prevent pest infestation. Both underground and surface storage structures are used for grain storage. While these are traditional storage practices still prevailing in many places, modern day cold storages are refrigerated structures used for perishable products like fruits, vegetables, milk, dairy and meat products. Cooling prevents deterioration in quality. Cold storage offers the option to keep products stored at the right temperature.

Packaging: Packaging or wrapping and crating products before they can be transported and sold is an important activity. They protect the product, reduces its bulk, facilitates handling and transportation, ensures cleanliness of the product and checks adulteration. All these together enhances the shelf life of the product. Different types of packaging materials are used for different products at different levels of marketing and distribution. These include gunny and cloth bags, wooden crates, straw baskets, PVC and plastic trays, corrugated fibre boards, tin, glass, aluminium foil and cardboard containers. The choice of packaging material and container depends on the nature of the product and marketing level. Factors such as the desired level of protective strength, attractiveness, consumer convenience, economy, and elimination of chemical reaction with the food product are important considerations in choice of materials for packaging. In case of processed products there is a mandatory requirement of providing essential information about packing like date of manufacturing and expiry, price, point of origin, etc. on the product labels. Thus, packaging should be such that they support the labelling requirements.

Check Your Progress 2 [answer in about 50 words using the space given]

1) State the four components on which the practices of sustainable agriculture rests?

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2) What does the practice of 'integrated use of nutrients' involve? In what way is it beneficial?

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3) What is 'irrigation scheduling'? In what way it is helpful as a crop production practice?

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4) State the four advantages of 'conjunctive use of water'.

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5) Among the different alternative irrigation methods, which is most beneficial from the point of view of 'water use efficiency'? Why?

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6) In which of type of region/area, the practice of 'contour farming' followed? In what way this method is helpful in minimising production/environmental losses?

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14.7 NEW AGRICULTURAL PRACTICES IN OPERATION

There have been a number of programmes to propagate the new agricultural practices. These are gaining importance both in terms of state sponsored initiatives, voluntary initiatives by farming community and, of course, promotional programmes as a part of corporate business interest. Some of these initiatives, which involve overlap of the four practices discussed above, are outlined in this section briefly.

14.7.1 Non-Pesticide Management

There is increasing consciousness about the excessive use of pesticides which raises cost of cultivation and also cause serious damage to environment as much as to the health of practising farmers. The Government of Andhra Pradesh promoted non-pesticidal management (NPM) programme as a part of the scheme called Community Managed Sustainable Agriculture (CMSA). Launched in 2004, as part of the farmers' field school, farmers under CMSA learn to identify insects, pests/predators and their life cycles and develop pest calendars. They also learn to make best use of natural resources and locally available material in crop management. The following are some of the practices farmers adopt under this:

- Early ploughing to destroy the soil borne harmful insects at larva/egg stage.
- Seed treatment for pest minimisation and better germination with ash, cow urine, etc.
- Pheramone traps, sticken plates and bonfires at right season and right places to minimise insects.
- Green sprays.

Besides health and environmental benefits, the main thrust of NPM under CMSA was to reduce farmer's cost without reducing their yields. Within a short period of four years (2004-2008), the NPM spread from a modest 25000 acres in 10 districts to 6.75 lakh acres across 18 districts in Andhra Pradesh.

14.7.2 System of Rice Intensification (SRI) Cultivation

The System of Rice Intensification, known as SRI, is a set of farming practices developed to increase the productivity of land and water, as well as other resources. SRI is based on the principle of developing healthy, large and deep root systems that can better resist drought, water logging and wind damage. It consists of elements to better manage inputs, utilize new ways to transport seedlings, and to manage water and fertilizer application. SRI is derived largely from farmer experimentation and local institutional innovation. The reported benefits of SRI are: increase in paddy yields, better rice quality, reduction in irrigation water use, and reduction in production cost. With climate change, increasing variability of rainfall, and with the growing competition for water and land, SRI offers a new opportunity for increasing the production per drop of water and for reducing agricultural water demand. Further, the organic inputs used in SRI are obtained locally with no production or transportation costs. They improve the soil's productive capacity in the long run. These practices also result in huge energy saving and reduced green house gases. Another offshoot of SRI is that similar methods and practices are now extended to other crops like maize, pulses and even wheat.

14.7.3 Organic Farming

The growing concern on threat of chemical fertilizers and pesticides to not only soil health but also human health has taken the shape of growing demand for food and fibre grown without the use of chemicals as fertilizers or pesticides. This has resulted in a movement in agriculture towards 'organic farming' and has become a world-wide phenomenon. Its success in India depends on the proactive role of the government in evolving institutional mechanisms for certification with minimum hassles to small-marginal farmers. Such efforts are as yet nowhere in sight and the whole certification process is under the control of international commercial conglomerates which mean unaffordable costs to farmers in countries like India.

14.7.4 Adoption of Conservation Agricultural Practices

Conservation agriculture (CA), as mentioned before, aims to achieve sustainable and profitable agriculture. As a consequence, it also aims at improving the livelihoods of farmers through the application of the three principles: minimal soil disturbance, permanent soil cover and crop rotation. CA holds tremendous potential for all sizes of farms and agro-ecological systems, but is most urgently required by smallholder farmers, especially those facing acute labour and water shortage. It is a way to combine profitable agricultural production with environmental concerns and sustainability. It is perceived by practitioners as a valid tool for Sustainable Land Management (SLM).

It is because of this promise that FAO is actively involved in promoting CA, especially in developing and emerging economies. CA can only work optimally if the different technical areas are considered simultaneously in an integrated manner. The multidisciplinary nature of CA will always require the rich mix of expertise available to FAO as it works to promote the CA concept worldwide. Table 14.1 shows the extent of application of CA practices across continents. Clearly, Asia is among the lowest to catch-up on CA practices with South America and North America among the leaders in this report.

Table 14.1 Global Adoption of Conservation Agriculture

Continent	Area (000 ha)	% of Global Total	% of Arable Crop Land
South America	55630	47.6	57.5
North America	39981	34.1	15.4
Australia & New Zealand	17162	14.7	69
Asia	2630	2.2	0.5
Europe	1150	1.0	0.4
Africa	368	0.3	0.1
Global Total	**116921**	**100**	**8.5**

Source: Regional Dialogue .... 2011 (For details see references)

14.8 LET US SUM UP

The need for meeting the growing needs of our huge population necessitated the approach adopted under the green revolution agricultural methods/practices. This helped the country attain a state of food sufficiency and a surplus for export. Alongside this achievement, owing to critical needs experienced on the fronts of productivity and sustainability concerns, improvement in production practices and methods pursued occupied the centre stage of policy on agricultural development. Over time, the Indian agricultural system has adopted many self-learnt and scientifically researched practices. These have helped achieve environmentally friendlier methods of production practices. Among the other purposes that these practices have helped achieve are: increased production, higher incomes, soil and water resource efficiency, reduction in post-harvest loss, etc. The unit has outlined the various methods and practices developed and implemented over the last five decade period in India.

14.9 KEY WORDS

Organic Materials : Organic fertilisers are natural materials of plant or animal including livestock manure, green manures, crop residues, household waste and compost. Such materials are used as fertilisers either directly or after they are cycled as animal or human food.

Bio-Fertilisers : Are artificially multiplied cultures of certain soil organisms that can improve soil fertility and crop productivity. They are preparations that have living cells of efficient strains of micro-organisms as active ingredients.

Sequential Multiple Cropping : Refers to the practice of cultivation of short duration crop varieties with intensive input management.

Integrated Use of Nutrients : Is a practice which involves the efficient and judicious supply/use of all important nutrients required by the plants/crops in a balanced manner. This helps to restore and improve the chemical and physical properties of soils.

Irrigation Scheduling : In order to control the ill effects of deficit/ surplus amount of water to crops, 'irrigation scheduling' is followed as a practice. It involves the fine-tuning of the time and amount of water applied to crops. This is based on factors like: the water content in the crop root zone, the amount of water consumed by the crop since it was last irrigated and during the crop development stage, etc.

14.10 SUGGESTED REFERENCES FOR FURTHER READING

1. Handbook of Agriculture (2011). Indian Council of Agricultural Research, New Delhi.

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3. Regional Dialogue on Conservation Agriculture in South Asia: Proceedings and Recommendations, APAAR, CIMMYT and ICAR, New Delhi, 2011.

4. Sangwan, Satpal (2000). Level of Agricultural Technology in India (1757 – 1857). *Asian Agri-History*, 11 (1): 5 – 25.

5. V&A Programme (2009), The System of Rice Intensification: Vulnerability and Adaptation Experiences from Rajasthan and Andhra Pradesh, SDC V&A Programme, India.

14.11 ANSWERS/HINTS TO CYP EXERCISES

Check Your Progress 1

1) See 14.1 and answer

2) See 14.2.2 and answer

3) See 14.2.2 and answer

4) See 14.2.5 and answer

Check Your Progress 2

1) See 14.3 and answer

2) See 14.3.2 and answer

3) See 14.3.3 and answer

4) See 14.4.1 and answer

5) See 14.4.2 and answer

6) See 14.5 and answer