

9. The most useful tillage operations depend on the most critical needs. Where weeds are a problem, one or two cultivations are very effective. Where drying and warming are problems, light disking to incorporate residues partially and leave some soil barren of cover is critical. Where surface flow furrow irrigation is planned, ridge-furrow construction is the most essential tillage operation.

10. For sustained agriculture on the land, reduced tillage should have these as its priorities, in order of decreasing importance: (a) erosion control, (b) weed control, (c) pest control, (d) preparation for surface irrigation, (e) minimizing environmental pollution, (f) reducing required land preparation time, and (g) reducing fossil-fuel energy needs (future fuel costs will increase rapidly).

CROPPING PATTERNS (Cropping Systems)

The kind and sequence of crops grown over a period of time on a given area of ~~soil~~ can be described as the cropping system. Cropping pattern may be defined as the distribution of the area of a farm to the various crops grown, in any specified year, in an agro-ecological zone. It may be a pattern of regular rotation of different crops or ~~one~~ of growing only one crop, year after year on the same area. Cropping pattern is related to general cropping systems practiced by the farmers in an ecological zone, depending upon climatic and edaphic factors. In contrast to cropping pattern, **cropping scheme** means the assignment or allocation of area to different crops being grown on a particular farm in a year. It is the arrangement of crops which relates to individual farmer, that is, on his farms. Factors that affect the cropping patterns/schemes, are discussed as under:

1. **Soil:** Soil is basic resource. The capability of soil to produce crops, grow pastures, raise forest trees or to support livestock differs greatly. Soil type, soil texture, and soil topography have great importance on cropping pattern. The rise in water table, occurrence of salinity and poor drainage also influence the cropping pattern in a particular region.
2. **Climate:** The climate and precipitation, its intensity and distribution in a region determine the kind of crops that can be grown.
3. **Availability of irrigation water:** In the arid and semi arid regions, as natural precipitation is inadequate for meeting the water requirements of crops, agriculture depends as much on the availability of water for irrigation as on the land resources. The type of crops that can be grown as well as the intensity of cropping are, therefore, determined by the water availability. The development of canal system where it did not exist before, or availability of ground water suitable for crops growth, helps to modify, or change the cropping pattern of those regions.

4. **Type and system of farming:** Cropping pattern used in dairy farming is quite different from vegetables and arable farming. Similarly, tenant cultivation differs from direct cultivation as far as cropping pattern is concerned. Likewise diversified farming or mixed farming and subsistence farming have their effect on cropping pattern.
5. **Technical skill of the farmers:** Farmers who possess some latest knowledge of agricultural achievements and are educated, having some experience in farm management will adopt better cropping pattern, such as, those having high cropping intensity or those aiming at restoration of soil productivity.
6. **Availability of seed and fertilizer:** If good seed of particular crop is not available, then there is a possibility that the farmers may not try to sow that crop. Similarly, sure and timely supply of fertilizer have a great effect on cropping pattern.
7. **Control of pests and diseases:** In certain cases, when a farmer thinks that the pest and disease may not be controlled in time, or it is uneconomical to apply the control measures, he will refrain from growing that crop.
8. **Availability of labour:** Farm operations like sowing, hoeing, and harvesting require seasonal labour. Thus, skilled and trained labour availability affects greatly the cropping scheme (pattern).
9. **Marketing conditions:** Such as supply, demand, suitable market, etc., and resources of farmers i.e., capital required greatly affects cropping pattern.
10. **Government policies:** Government policies and laws also affect the cropping pattern. For example government encourages the growth of certain crops, or enforces certain laws prohibiting the cultivation of a particular crop. For example, poppy cultivation is not allowed in Pakistan.
11. **Effect of competition among crops:** There are certain crops which compete with each other for water and other agronomic factors. A change in the acreage of one crop is likely to have an influence on the acreage of competing crops. Wheat, toria and gram are the competing rabi crops. Similarly, sugarcane and cotton are the competing kharif crops. An increase in sugarcane acreage is likely to have a depressing effect on cotton crop.
12. **Social factors:** The density of population in an area creates pressure of population on land. Upto a certain stage, the rising population creates the labour resource for agriculture. As with the rising population, the average size of holding becomes smaller, the farmer and the agricultural region can react in two ways:

(a) More and more farms and ultimately the unit of farming, becomes a subsistence unit, with the result the area under food and fibre crops increases and the area under cash crops is decreased.

(b) More and more of the land holders will leave agriculture as their means of living and will seek employment in industries. They will sell or lease their holdings. There will be a tendency towards increased size of holdings.

Types of cropping patterns:

1) **Mono cropping:** Growing one crop again and again in the same area. This is done where land is poor and low in fertility, population pressure is less, facilities for irrigation are low and seasonal. It results in low income and often has risk of no income, no soil improvement, and more erosion hazards.

2) **Multiple cropping:** Growing of two or more crops on the same piece of land in the same season or in different seasons of a year. For two crops, the term usually used is **double cropping**. Multiple cropping is done where: land is fertile, labour is abundant, irrigation water and other inputs are available and holdings are small. It is advantageous as it results in better utilization of resources, there is less risk of erosion, and more land improved. Multiple cropping refers to the intensification of cropping in time and space dimensions.

1) **Sequential cropping:** Growing two or more crops in sequence on the same field per year. The succeeding crop is planted after the preceding crop has been harvested. Crop intensification is only in the time dimension. There is no intercrop competition. Farmers manage only one crop at a time in the same field.

Double cropping: Growing two crops a year in sequence.

Triple cropping: Growing three crops a year in sequence.

Quadruple cropping: Growing four crops a year in sequence.

Ratoon cropping: The cultivation of crop regrowth after harvest, although not necessarily for grain.

1) **Intercropping:** Growing two or more crops simultaneously on the same field. Crop intensification is in both time and space dimensions. There is intercrop competition during all or part of crop growth. Farmers manage more than one crop at a time in the same field.

Mixed intercropping: Growing two or more crops simultaneously with no distinct row arrangement.

Row intercropping: Growing two or more crops simultaneously where one or more crops are planted in rows.

Strip intercropping: Growing two or more crops simultaneously in different strips wide enough to permit independent cultivation but narrow enough for the crops to interact agronomically.

Relay intercropping: Growing two or more crops simultaneously during part of the life cycle of each. A second crop is planted after the first crop has reached its reproductive stage of growth but before it is ready for harvest. *Always cropping (e.g. fodder crop in pasturing of fields) or more crops in always (e.g. fodder crop in pasturing of fields)*

CROP ROTATIONS

Crops remove fairly large quantities of nitrogen, phosphorus, and potassium from the soil. The yield from continuously cropped soils, decreases over time and ultimately it becomes uneconomical to cultivate them. In order to maintain the drain on the soil by keeping it fallow, by measures such as reducing the drain on the soil by keeping it fallow, allowing an interval between crops of different seasons, or adding nutrients to the soil in the form of manure and fertilizer. Early agricultural experiments showed the value of crop rotations that included a legume sod crop in the regular sequence. Such a system generally maintains productivity, and prevents soils degradation and nutrient depletion. **Crop rotation is the sowing of crops in a regular order, one after the other on the same land for a fix period keeping in view that the fertility of soil may not be adversely affected.** Technically speaking, crop rotation is the raising of crops from a piece of land in an order or succession so that the soil fertility is least suffered. Different crop rotation systems have been practiced in Pakistan from the time immemorial. This system is in contrast with the practice of growing the same crop, year after year. The objective is to ensure increased crop production and have better quality crop produce by maintaining and increasing soil fertility and improving soil productivity through raising of different natured crops in an order from a piece of land. Modern crop rotation was established about the year 1730, in England.

Principles of crop rotation: There are some important botanical principles and management considerations involved in setting up crop rotations. The mechanics of setting up a good crop rotation can be summarized as follows:

1. Crops of the same natural order, that is, belonging to the same family should not follow each other.
2. Crops of the same root system (shallow or deep) should not follow each other.
3. Leguminous crops must be included in the rotation.

iii. RELAY CROPPING:

This involves the seeding of the second crops in same field before the harvest of first one. The crop sown first is usually in reproductive stage. In this system part of the life cycle of one crop overlaps that of the other. Two such examples are planting of sugarcane in sugarbeet, and berseem in cotton.

7.6 CROPPING INTENSITY:

The term cropping intensity (C.I.) is related to land use by crops in a specific period of time. It refers to the percentage of the total cultivated land that is occupied by crops in one year. It is calculated as follows:

$$C.I = \frac{\text{Total cropped area} \times 100}{\text{Total cultivated area}}$$

If the total cultivated area is 20 ha. Out of this 10 ha was cropped in kharif and 5 ha in rabi, the cropping intensity (C.I) would be 75%, calculated as:

$$C.I. = \frac{10 + 5 \times 100}{20} = 75\%$$

When the entire farm land is occupied by a single crop for one year, the intensity would be 100 %, but if two crops (one in kharif and the other in rabi season) are grown in one year, the intensity would be 200 %. Likewise, the intensity of a triple cropping pattern will be 300 % and that of quadruple 400%. An increased cropping intensity means more production per year from a specific piece of land.

Cropping intensity of the various cropping patterns of Pakistan varies from 100 to 400 % (Table- 1). The intensity is minimum in Barani area of the country where the subsistence farmers commonly grow only one crop (wheat or chickpea). In

irrigated areas progressive farmers grow two or more crops and thus have higher intensity of their land.

In the rotation sequences which spread over two or more years, the intensity is calculated as follows:

$$C.I = \frac{\text{No. of crops grown} \times 100}{\text{No. of year}}$$

As an example, the cropping intensity of a two years rotation including three crops, wheat-fallow-wheat-cotton, and would be:

$$C.I = \frac{3 \times 100}{2} = 150\%$$

Note that the word 'fallow' means that the land or field is without any crop. The cropping intensity of some common rotation sequences is given in Table- 7.2. It varies from 100 to 200%. Cropping intensity in the NWFP (Table- 7.3) varies from 73% in Kohat to 186% in Swat, the provincial mean being 106% according to 1999-2000 statistics.

Maximum cropping intensity is the need of the time. It is more profitable, and can meet the demand of the growing population. Cropping intensity can be increased by inter cropping and relay-cropping systems. In most irrigated areas of our province (Peshawar and Mardan) three crops can be grown in a year. For example, wheat + sugarcane (dormant) + tomato or onion in spring. The intensity in this particular case would be 300%. Such an increase in cropping intensity is only possible by the availability of enough water, fertilizer, labour and managerial skill. Modern farming relies on such factors and thus achieves maximum cropping intensity.