

Selection of appropriate Land Use and Cropping Pattern in view of climatic condition

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INTRODUCTION

The emissions of heat-trapping greenhouse gases from energy, industrial, agricultural, and other human activities like the changes in land use (activities taking place on land, like growing food, cutting trees, or building cities) and land cover (the physical characteristics of the land surface, including grain crops, trees, or concrete) affect the climate. For example, cities are warmer than the surrounding countryside because the greater extent of paved areas in cities affects how water and energy are exchanged between the land and the atmosphere. This increases the exposure of urban populations to the effects of extreme heat events. As a result, decisions about land use and land cover can therefore affect, positively or negatively, how much our climate will change and what kind of vulnerabilities humans and natural systems will face.

Land use

The land is a basic and indispensable resource for agriculture. Its quality and extent largely determine the variety and magnitude of agriculture production. The land utility depends upon the soil, topography, climate and water resources. Therefore, the agricultural activities of man are restricted on the land surface.

The utilization of surface for all developed and vacant land on specific space at a given time is called land use. Land use is a geographical concept since it involves specific areas. The land is used for the purposes such as-

- Crops,
- Forests,
- Pastures,
- Mining,
- Transportation,
- Residential,

- Recreational,
- Industrial and
- Commercial use.

Land use change may be examined by considering the conversion of forest to crop and rangeland, loss of productive land through various factors, conversion of wetlands to agriculture and urban use, and conversion of other types of land to various human uses. Land classification is based largely on the quality and intensity of the use of land.

Cropping pattern

Cropping pattern means the proportion of area under various crops at a point of time, which means the yearly sequence and spatial arrangement of crops or crops and the fellow on a given area. A cropping pattern is, however, a dynamic concept as it changes over space and time. The cropping pattern is influenced by the physical factors such as-

- Soil,
- Climate and
- Technological factors like irrigation, improved varieties of seeds, availability of fertilizers, and plant protection chemicals.

Climate plays a crucial role in determining the existing cropping pattern. From the time the crops are sown, till the produce is harvested and stored, they are more or less at the mercy of the climate. The cropping pattern varies from region to region due to the variation in-

- Terrain,
- Amount of reliability of rainfall,
- Use of fertilizers, pesticides and mechanization
- Slope,
- Soils,
- Temperature,
- Availability of water for irrigation,

The decisions concerning the choice of crops and cropping systems are further narrowed down under influence of several other forces related to infrastructure facilities, socio-economic factors and technological developments, all operating interactively at the micro-level.

These other factors are:

- Infrastructure facilities: Irrigation, transport, storage, trade and marketing, post-harvest handling and processing etc.
- Socio-economic factors: Financial resource base, land ownership, size and type of landholding, household needs of food, fodder, fuel, fibre and finance, and labour availability, etc.
- Technological factors: Enhanced varieties, cultural requirements, mechanization, plant protection, access to information, etc.

Changes in land-use: change climate

Land-use change is one type of human activity that is causing changes in Earth's climate. "Land-use changes (e.g. cutting down forests to create farmland) have led to changes in the amount of sunlight reflected from the ground back into space (the surface albedo). The scale of these changes is estimated to be about one-fifth of the forcing on the global climate due to changes in emissions of greenhouse gases.

Except for climate change studies, there are few reliable records of past changes in land use. One way to build up a better picture of the effects of past changes is to combine surface records of changing land use with satellite measurements of the properties of vegetation cover. Such analysis shows that forest clearing for agriculture and irrigated farming in arid and semi-arid lands are the two major sources of climatically important land cover changes.

Changes in the Cropping Pattern and land use

A change in agricultural land use implies a change in the proportion of area under different crops at two different times. The proportion of area under different crops at a point in time means the cropping pattern of that area. When the area under different crops changes at two different times then, it is called the change in cropping pattern.

Land-use change is related to climate change as both, a causal factor and a major way in which the effects of climate changes are expressed. As a causal factor, land-use influences the flux of mass and energy, and as the land-cover pattern changes, these fluxes are altered. Projected climate alterations will produce changes in land-cover patterns at a variety of

temporal and spatial scales, although human uses of the land is expected to override many effects. The relationship between land-use change and climate change clearly shows that-

(1) In recent centuries, land-use change has a much greater effect on ecological variables than climate change;

(2) The vast majority of land-use changes have little to do with climate change or even climate; and

(3) Humans will change land use, and especially land management, to adjust to climate change and these adaptations will have some ecological effects.

Impact of agriculture on climate change

The agricultural sector is a driving force in the gas emissions and land-use effects thought to cause climate change. In addition to being a significant user of land and consumer of fossil fuel, agriculture contributes directly to greenhouse gas emissions through practices such as rice production and the raising of livestock according to the Inter-governmental Panel on Climate Change, the three main causes of the increase in greenhouse gases observed over the past 250 years have been fossil fuels, land use, and agriculture. Agriculture contributes to greenhouse gas increases through land use in four main ways:

- CO₂ releases linked to deforestation,
- Methane releases from rice cultivation,
- Methane releases from enteric fermentation in cattle,
- Nitrous oxide releases from fertilizer application.

Together, these agricultural processes comprise 54% of methane emissions, roughly 80% of nitrous oxide emissions, and virtually all carbon dioxide emissions tied to land use.

Diversification of cropping patterns in India

The Cropping patterns in India underwent several changes with the advent of modern agricultural technology, especially during the period of the Green Revolution in the late sixties and early seventies. There is a continuous surge for diversified agriculture in terms of



crops, primarily on economic considerations. The crop pattern changes, however, are the outcome of the interactive effect of many factors which can be broadly categorized into the following five groups:

- Resource related factors covering irrigation, rainfall and soil fertility.
- Technology related factors covering not only seed, fertilizer, and water technologies but also those related to marketing, storage and processing.
- Household related factors covering food and fodder self-sufficiency requirement as well as investment capacity.
- Price related factors covering output and input prices as well as trade policies and other economic policies that affect these prices either directly or indirectly.
- Institutional and infrastructure-related factors covering farm size and tenancy arrangements, research, extension and marketing systems and government regulatory policies.

The major change in cropping pattern that has been observed in India is a substantial area shift from cereals to non-cereals. Although cereals gained a marginal increase in area share in the first decade of the Green Revolution, their area and share declined gradually thereafter.

The two most important ways of achieving agriculture development through the change in cropping patterns are:-

- (a) Adoption of new crops and
- (b) Intensification of cultivation of land through multiple cropping.

Climate-smart Agriculture and land use plan

Agriculture that sustainably increases productivity, resilience (adaptation), reduces or removes greenhouse gases (mitigation) and enhances achievement of national food security and development goals is known as climate-smart agriculture. For each land unit, crop and technology portfolio, whenever the criteria of productivity increase, income increase and emission intensity decrease are met, it was termed as climate-smart land use for that period and climate scenario.



The overall efficiency, resilience, adaptive capacity and mitigation potential of the production systems can be enhanced through improving its various components, some of the key ones are highlighted below:

- Soil & nutrient management,
- Water harvesting & use,
- Pest & disease control,
- Resilient ecosystems,
- Genetic resources,
- Harvesting, processing & supply chains,

Long-term adaptations are major structural changes to overcome adversity such as changes in land-use to maximize yield under new conditions; application of new technologies; new land management techniques; and water-use efficiency related techniques.

Major classes of adaptations are:

- Seasonal changes & sowing dates,
- Different varieties or species,
- Water supply & irrigation system,
- New crop varieties
- Forest fire management,
- Promotion of agro-forestry,
- Other inputs (fertilizer, tillage methods, grain drying, other field operations)
- Adaptive management with suitable species and silvicultural practices.