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Review Article

SUSTAINABLE RELATIONSHIP WITH EARTH'S CLIMATE: INTERACTION OF GEO AGRI REGIONS

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ABSTRACT

Climate is changing at an unprecedented rate and the magnitude of change is highly variable from place to place. Plants in varying habitat have different characteristics. Crops require tolerance to different abiotic stresses depending on their agro climatic region. Rice can thrive in waterlogged soil that would kill other crops, but is highly sensitive to drought and cold. Adapting crop varieties to local ecological conditions will reduce risk due to climate change. However, varieties improved for cultivation in one region could be adopted for cultivation elsewhere where they will successfully meet the environmental challenges. The present review will describe agri geo climatic changes on plant cultivation and growth.

Keywords: Cultivars, Climate change, Agri geo climatic changes, Sustainable development.

INTRODUCTION

World has different climatic zones and vegetation differs in these regions. Climate is changing at an unprecedented rate and the magnitude of change is highly variable from place to place. This floristic diversity is spread over the natural habitats in different vegetation or forest types. It is in the remotely located areas in forests, where the native tribes live. They use the plant wealth of their surroundings and practice Climatic changes cause variable effect on agriculture, forestry and plant productivity. Plants of different regions respond differently. A halophytic plant can better tolerate the salinity as compared to mesophytic plant. Global climate is changing and new challenges are posed by abiotic and biotic stresses on plant life. Biotechnological innovations permit genetic engineering of plant to make them adapt to the new climatic conditions. Increasing temperatures globally can promote agriculture in Europe but will harm the same in South East Asia. The W.H.O. has estimated that perhaps 80% of earth's 6 billion inhabitants depend upon traditional medicine for their primary health care needs and a major part of this therapy involves the use of plant extracts for their active principles[3]. Scientists in many parts of the world have carried out extensive researches and have proved to the humanity the effective use of herbal medicine. Diversity in species, varieties and practices has permitted agriculture to withstand moderate change in climate over the past 10,000 years.

Climatic zones:

World has different climatic zones as indicated in Fig 1. Tropical plants differ from temperate plants and adaption to different climate is a big challenge. Mesophytes, Halophytes, xerophytes and hydrophytes are major categories of plants of these regions. Polar zones are devoid of plants[6].

Figure 1: Map of the world showing different climatic regions of world.

Indian subcontinent:

The Indian sub-continent is unique in the richness of its plant wealth. Over 14,000 species of higher plants occur in India, of which about 9,100 have multiple economic uses. Of these, 7,500 have medicinal value, 3,800 are edible, 700 are culturally important, 525 are used for fibre, 400 for fodder, 300 for pesticides and insecticides, 300 for gum, resins and dye and 100 provide incense and perfume[5].

The climatic regions of India vary from hot dry deserts to the wettest regions on the earth and from tropical to cold alpine regions2. Consequently, the country possesses a vast variety of forest types and arboreal species (Fig 2).

1. **Tropical Wet Evergreen forests:** These forests extend along the Western Ghats. These occur in regions with an annual rainfall of 290-320cm, short dry season (of about 3-4 months) and a mean annual temperature of 26-28ºC. The floras most widely distributed are *Hopea*and. *Dipterocarpus*. Other components are Meliaceae, Anacardiaceae, Guttiferae.
2. **Tropical Semi-Evergreen Forests:** These forests are confined to low hills and undulating ground and may also occur on flat plateau. These forests occur in regions where there is adequate moisture but not enough for evergreen vegetation. The average rainfall varies from 2,000-2,500mm and the dry season longer. Flora consists of evergreen as well as deciduous trees. Species of *Xylia, Terminalia,* and *Sterculia* are found here.
3. **Tropical Moist Deciduous Forests:** These occur in all parts of India with medium rainfall of 10-25cm, and a mean annual temperature of 24-27ºC. The chief feature is a period of leafless existence in the dry season, generally in March and April. Principle species found here are *Cassia fistula, Tectona grandis*various species of *Terminalia, Pterocarpus, and Adina* are also present.
4. **Littoral And Swamp Forests:** These include what are known as beach and dune forests and mangroves. The soil is mostly sea sand. Characteristic of the beach forest are *Casuarina, Calophyllum Equisitifolia, inophyllum,* and *Pandanus*.
5. **Tropical Dry Deciduous Forests:** Such forests occur in regions with an average rainfall of 90 to 130cm. and long dry season of 6 months.Ethnobotany in Rajasthan is still in its infancy. Even very little is known about its biodiversity. A large number of plant species which have high medicinal value and are used by local people of Rajasthan as tribal medicines are found in arid and semi arid regions of Rajasthan.*Tectona grandis, Acacia catechu, Boswellia serrata, Sterculia urens, Tamarindus indica* and *Shorea robusta* are commonly found here.
6. **Tropical Thorn Forests:** They occur in semi arid regions with short period of annual rainfall ranging from a total of 50-90days in a year. There are open forests of thorny trees. The dominant genus is *Acacia*. Thar desert of Rajasthan is also highly rich in medicinal plant diversity. Some very important medicinal plants of potent medical value have been discovered through ethnobotanical survey of Thar Desert in Rajasthan[10]. The principle species are *A. catechu.* Other thorny species *Mimosa, Zizyphus* and *Euphorbia* spp are also found.
7. **Tropical Dry Evergreen Forests:** Trees are about 9-12m high and form a complete canopy. Shrubs and creepers form the undergrowth. Mean annual temperature is 27-28ºC, dry season varies from 3 to 6 months. The commonest genera are *Manilkara*. (Melastomaceae) and *Eugenia*.
8. **Sub-Tropical Pine Forest:** Found all along the Himalayan region from north west frontier to extreme north east covering Sikkim and extends further into Assam. Rainfall varies from 150-300cm. Predominant broad leaved trees are *Quercus* associated with *Rhododendrons, Mallotus* etc. The pines are *Pinus roxburgii. Pinus insularis*[8].
9. **Montane Wet Evergreen Forests:** Occur in the hills of south India at the height exceeding 1,500m and also in north in the Himalayan regions. Common species found in south are *Ternstroemia gymnathera, Eugenia calophyllifolia,* etc. In the north *Q. pachyphylla, Quercus lamellosa, Rhododendron arboreum* etc are common.
10. **Himalayan and Subalpine Forests:** These give place to mixed coniferous forests of Deodar, Spruce, Blue Pine etc at higher altitudes. In the western and central Himalayas, there are deciduous forests known as Ban Oak forests *(Quercus incana)* and Moru Oakforests *(Quercus dilata)*. Gradually, these forests pass into parklands and ultimately into open pastures. Rhododendrons occur at height of 3,500m - 5,000m.
11. **Alpine Pastures:** They are situated very high at 4,000 to 5,000m. The precipitation here is generally in the form of snow. The alpine meadows, though reckoned among grasslands, have very little grass. The principle vegetation, consisting of perennial mesophytic herbs, *Primula, Anemone, Gentiana, Iris* and spread their bloom in summer in regions lying just below the snow line.

Himalayan region:

The Himalaya is inhabited by a large population, often with their distinct way of life, beliefs, traditions, dialects and cultural heritage[1,8]. There are number of plants growing in the Himalayan terrain which have great medicinal value[4]. The tribals have learnt to utilise indigenous plants in various ways; many of these plants have come to be used in the treatment of different diseases after centuries of trials. The Himalaya has bestowed them with vast, varied and even endemic plants. The folk medicine of the Himalaya has gifted many plant drugs to modern medicine such as *Tylophora indica* (for asthma and whooping cough), *Rauvolfia serpentina* (for high blood pressure), *Nardostachys grandiflora* (sedative), *Viola serpens* and *Adhatoda vasica* (for bronchitis)[9].

Figure 2: Map of India showing different agro climatic zones

Plant breeding:

Plant breeding, is a long-term exercise and there is usually a lag phase of about 7-8 years between variety development and adoption by farmers[7]. Crops require tolerance to different abiotic stresses depending on where they are grown. Adapting crop varieties to local ecological conditions will reduce risk due to climate change; however, varieties improved for cultivation in one region could be adopted for cultivation elsewhere, where they would face the same abiotic and biotic stresses. The wild plants related to traditional and modern crops harbour an abundant supply of resistance genes. Crop wild relatives have saved the agricultural industry millions of dollars, directly and indirectly, by improving crop resilience to biotic and abiotic stresses.

DISCUSSION

Climate change will cause shifts in areas suitable for cultivation of a wide range of crops. Areas suitable for cultivation of a wide range of the world's most important crops will shift as a result of climate change. The impact of climate change on production of various crops varies markedly depending mainly on the region, growing season, the crops and their temperature thresholds. Introduction altered and unpredictable weather patterns can increase crop vulnerability to pests, diseases and the effects of extreme climate events such as high temperatures, droughts and torrential rains. International Treaty on Plant Genetic Resources for Food and Agriculture and other major staple and cash crops ensures genetic fidelity. Sub-Saharan Africa and the Caribbean area are most detrimentally affected. Conversely, Europe and North America will see an increase in area suitable for cultivation with increase in temperatures. These regions have the greatest capacity to manage climate change impacts. Cereals, oilseed and protein crops depend on temperature and, in many cases, day length, to reach maturity. To minimize the impacts of these climate and other environmental changes, it will be crucial to breed new varieties for improved resistance to abiotic and biotic stresses is. Local knowledge of ecological interactions, traditional varieties, and the genetic diversity in the wild relatives of domesticated crops provide rich resources on which to build priority breeding programmes for climate. The objective is to identify the crops and regions potentially most afflicted by climate change.

CONCLUSION

Climate is changing at an unprecedented rate and the magnitude of change is highly variable from place to place.To minimize the impacts of these climate and other environmental changes, it will be crucial to breed new varieties for improved resistance to abiotic and biotic stresses is.. The wild plants related to traditional and modern crops harbour an abundant supply of resistance genes. Crop wild relatives have directly and indirectlyin improving crop resilience to biotic and abiotic stresses.

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