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## **Future of Natural Resources in Haryana**

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**ABSTRACT :**It is necessary to enhance the Department of Agro-meteorology in order to incorporate climate change mitigation and adaptation strategies into research and development of natural resource management. This will enable the implementation of climate smart and weather forecast based agriculture in the State. The primary contributors to greenhouse gas (GHG) emissions and global warming in the country include the escalated utilization of fossil fuels, the practice of puddled rice agriculture, and the substantial number of bovine cattle. The research findings indicate that C3 crops will experience positive effects from increased CO<sub>2</sub> levels. However, the rise in temperature associated with global warming will lead to increased water usage, shorter maturation periods, and decreased production.

**Keywords :** Natural Resource. Resource Management, agriculture, water management, soil conservation, Haryana, HAU Hisar

**INTRODUCTION :**Haryana was established as a distinct state from Punjab on November 1, 1966. It covers a total geographical area of 4.42 million hectares, which is equivalent to 1.4% of the country's total geographical area. Additionally, Haryana's population represents less than 2.6% of the country's overall population (Yadav and Kumar, 2010). With agriculture as the main source of income, around 85% of the land is used for farming, 3.52% is dedicated to forestry, and the rest is allocated for non-agricultural purposes.

Haryana State is situated within the geographical coordinates of 27°30' and 30°35' N latitude and 74°28' and 77°36' E longitude. It is a region within the northwestern dry and semiarid plains, characterized by an average annual rainfall of 545mm. The rainfall varies from 1200mm in the extreme northeast to less than 300mm in the arid western areas. The State is surrounded by the Siwalik hills to the north, the river Yamuna to the east, and the Aravali highlands to the south. The State is predominantly characterized by alluvial plains, which account for over 98% of its total area. These plains encompass the arid sand dunes found in the western region. The State is predominantly comprised of the flood plains of River Yamuna and Ghaggar, which are divided into three basins: Yamuna basin (16330 sq. km.), Ghaggar basin (10675 sq. km.), and Inland basin (17207 sq. km.), as shown in Figure 1. The elevation of the State ranges from 190 meters to 1200 meters above mean sea level (msl), as shown in Figure 2, which represents the resulting physiography. The plains of Haryana are characterized by a significant depression between the Siwalik hills and Aravali hills. This depression has resulted in a unique

internal drainage system in the central and western parts of the region, including the districts of Rohtak, Jhajjar, Bhiwani, Hisar, Sirsa, and parts of Sonapat (Fig 1). Haryana possesses a distinctive geographical characteristic whereby its water flows into both the Indus and Ganges basins.

The forested lands of Haryana State are diminishing as a result of adverse conditions, excessive grazing, the growth of agricultural land, and increasing urbanization. The primary aim of the Integrated Natural Resource Management and Poverty Reduction Project (INRMPPR) in

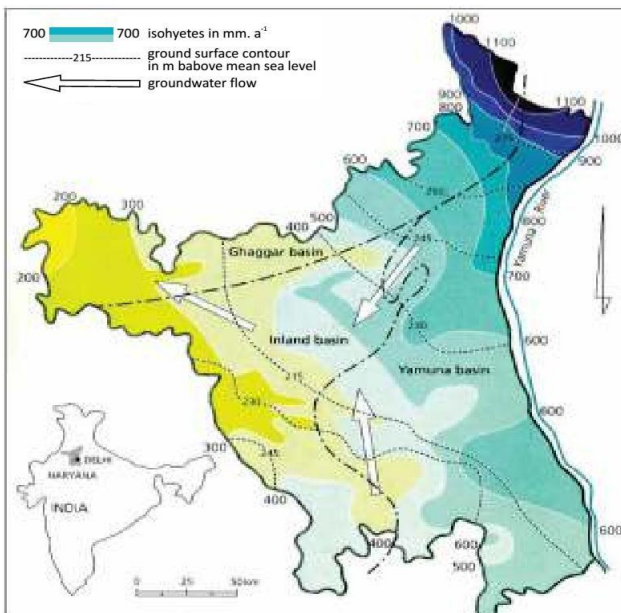


Fig.1: Geographic domain of Haryana

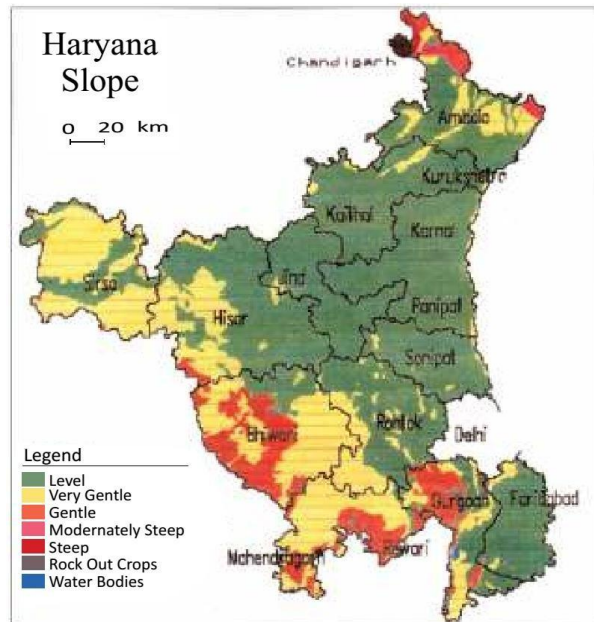


Fig.2: Haryana physiography

Haryana is to restore the forest ecosystem through activities focused on managing forest resources, including afforestation, watershed preservation, and soil conservation. The enhancement of living standards for the inhabitants of the forest and its surrounding areas will lead to enduring progress in both the natural environment and society within the region. The INRMPPR in Haryana is implementing afforestation efforts with community participation on a land area of roughly 50 thousand hectares. In addition, the project seeks to alleviate poverty through the implementation of minor infrastructure enhancements in rural areas and the provision of vocational training to assist individuals who rely on forests for their livelihoods in finding alternate means of income. Moreover, to enhance the organizational abilities of the Forest Department and the community, a range of instructional and awareness initiatives and training programs are being implemented. Efforts are being undertaken to facilitate afforestation activities and promote sustainability for the regenerated forests. The Children's Forest Program is being implemented as part of the INRMPPR in Haryana, in collaboration with the Japanese non-governmental

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organization, the Organization for Industrial, Spiritual and Cultural Advancement (OISCA).

The State has achieved substantial progress in food production and makes a considerable contribution to the national food supply. The Green Revolution has significantly increased the cultivated land, covering over 85% of the entire geographical area, with a cropping intensity of around 181%. Nevertheless, the current agricultural trends in productivity are disheartening. The uncontrolled utilization of natural resources in extensively farmed regions of Haryana has begun to exhibit adverse effects on soil fertility, a gradual decrease in the effectiveness of resource utilization and overall productivity, an increase in cultivation expenses, water and environmental pollution, and the vulnerability of agriculture to climate change. Consequently, this poses a significant challenge in sustaining a growth rate of 4% or higher in the agricultural sector of the state. If immediate measures are not made to provide farmers with the necessary knowledge and skills to address future challenges related to limited resources, the food security situation is bound to worsen.

## **NATURAL RESOURCES**

**Soil Resources :**The soil resources in the State are formed from alluvium in the plains, detrital and alluvial materials in the northern sub-mountain regions, aeolian material in the far western area, and alluvium modified by aeolian activity in the southern and southwestern parts of the State. In terms of taxonomy, Inceptisols are the most prevalent soils, covering around 58% of the territory. They are followed by Entisols, which occupy 28% of the land, Aridisols at 9%, and Alfisols at 2% . The predominant soil texture in the area is fine loamy, covering 43% of the total area. Coarse loamy soils comprise 34% of the area, while sandy soils cover 23%.

**Water Resources :** The combined potential of surface and ground water resources is assessed to be 1.51 m ha m and 1.24 m ha m respectively, totaling 2.75 m ha m when considering ground water of marginal quality . The northeastern region of the State is predominantly characterized by a significant presence of fresh groundwater, while the remaining 28,000 km<sup>2</sup> (about 60%) is characterized by the presence of brackish to very saline groundwater. Given the demands of urban and industrial sectors for water resources, the current available water resources can only satisfy around 60% of the irrigation needs. In the last 40 to 50 years, extensive efforts have been undertaken to utilize all accessible resources in order to fulfill agricultural requirements. The primary surface irrigation system consists of the Western Yamuna Canal, which originates from the Yamuna River, and the Bhakra Canal, which originates from the Sutlej River. The Western Yamuna Canal, built in 1351 AD by FerozshahTuglak and later renovated by King Shahjahan, is one of the oldest canals in the region that supplies water to Hisar. The secondary and tertiary canal systems in Haryana, such as Gurgaon, Jui, Indira Gandhi, B.

N. Chakraborty, and Jawaharlal Nehru lift irrigation schemes, are designed to elevate water in stages up to 174m. These systems are specifically implemented to provide irrigation to the sandy areas in western and southern Haryana.

**Climate and Agroecological Zones :** The State's water resources have played a crucial role in enhancing and maintaining agricultural production due to the semi-arid and dry environment of the region. The State experiences an unequal distribution of mean annual rainfall, with a total of 545mm. Additionally, the annual evaporation demand above 1500 mm. According to the GCM models, the Indian Sub-continental is projected to have a temperature increase of approximately 1.5°C by the middle of the present century. Additionally, the latter half of winter is expected to be warmer than the first half. Additionally, it is forecasted that the Indian sub-continent would have a 6% increase in rainfall, which may be characterised by erratic patterns and greater intensity. During the current century, there will be a decrease in the amount of incident radiation and an increase in the concentration of CO<sub>2</sub> and other greenhouse gases. Hence, it is imperative to implement suitable adaptation and mitigation strategies to tackle the repercussions of climate change on agriculture.

**Crops, Cropping Systems and Biodiversity :** The prevailing crops and farming systems in different sections of the State are influenced by agro-climatic resource conditions, water resource development, and State policy. The primary objective of research and development was to optimise crop productivity, with limited consideration for the sustainability of resource utilisation and management. The currently cultivated crop varieties are predominantly modern, characterised by their reduced height and high productivity, which have largely supplanted the old varieties previously embraced by farmers. The lack of focus on understanding and treating biodiversity and its dynamics has resulted in the creation of novel diseases and pests, which pose a severe danger to our agricultural base. For instance, the implementation of high-yielding strains of rice and wheat, along with enhancements in irrigation infrastructure and the adoption of chemical fertilisers, has resulted in a significant shift from cultivating indigenous sorghum, maize, and millets to mostly farming rice and wheat. The conventional native crops, with their naturally existing variations, which were not inherently high yielding, have numerous desirable traits such as resilience to various biotic and abiotic stressors, as well as superior quality.

**Agricultural Development and State of Natural Resources :** During the last forty years, the State has achieved substantial progress in achieving its objectives of improving agricultural output and making considerable contributions towards satisfying the increasing demand for food grains due to population growth and export requirements. The main focus of the strategy to achieve production goals was the expansion of the irrigated area through the construction of canals, minors, and lift canals. Additionally, support was

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provided for sinking tubewells, and measures were taken to improve credit and marketing. The availability and adoption of improved high yielding crop cultivars, as well as increased use of fertilisers and plant protection chemicals, were also important factors in achieving these goals. The Central Government has spearheaded these initiatives, which have been supported and executed by the State Government through various schemes. As a result, Haryana has emerged as a leading state in agriculture.

#### **STATE OF NATURAL RESOURCES :**

- HARSAC and SAU are working on creating a computerised database that tracks and analyses the current and changing conditions of land use, soil quality, water availability, climatic patterns, vegetation cover, and agricultural practises.
- HARSAC conducts regular mapping and characterization of natural resources, such as land, soil, water, climate, and vegetation cover, as well as natural calamities like drought and flood. This is done utilising advanced technologies of remote sensing and GIS.
- Conducting targeted analyses of land use-cover changes to examine the impact on resource availability and degradation, as well as socioeconomic and development challenges, in order to comprehend the underlying driving forces and provide potential solutions to solve these problems.
- Key challenges that significantly impact long-term agricultural development include: diminishing farm size and reduction of prime agricultural land, pollution of agricultural land and groundwater by industrial and sewage waste, limited expansion of forested areas, and degradation of vulnerable erosion-prone regions such as the Aravallis and Shivalics.
- Publishing the 'The State of Natural Resources' report in a digital format every five years. The initial report should be scheduled within the upcoming two years. CCSHAU and HARSAC must take the lead in this project.

#### **STRATEGIC, APPLIED AND ADAPTIVE RESEARCH**

- There is a need to significantly enhance the Regional Research Stations of CCS HAU in order to prioritise location-specific research and development agendas. This includes focusing on improving the connection between scientists and farmers, and implementing adaptive research projects in a participatory mode. The aim is to address the specific issues related to natural resource management in the state.
- Integrating climate change mitigation and adaptation measures into multidisciplinary strategic and adaptive research for development.
- Addressing hydrological imbalances by employing integrated strategies that encompass on-farm water management, conjunctive water usage, pressurised irrigation systems, water-saving devices, surface and subsurface drainage, aquifer recharge, diversification, intensification, conservation agriculture technologies, and a comprehensive watershed management approach.
- The improvement of low-quality groundwater in an inland basin by a cyclic process of



extracting and recharging groundwater with high-quality water on a small-scale pilot project, with the participation of farmers.

- Creating a comprehensive scientific package to utilise waste water in peri-urban regions of the State, namely for the cultivation of vegetables and fodder crops.
- Conducting a comprehensive assessment of completed projects in agricultural drainage, irrigation, watershed management, and agroforestry to determine their success in attaining the intended objectives.
- Implementing deliberate measures to replace puddled rice with alternative crops, such as cropping systems based on hybrid maize/soybean and the adoption of Conservation Agriculture (CA) technologies.
- Conducting location-specific initiatives to optimise various resource conservation strategies (such as DSR, diversification, intensification, raised bed planting, residue integration, brown manuring, etc.) within different production systems.
- Exploring alternative solutions for managing crop residue in the ricewheat and cotton-wheat cropping system, as well as utilising biochar derived from crop residue to promote carbon sequestration.
- The objective is to integrate farming system research into mainstream practises, with the goal of gaining a deeper understanding of the views of farmers, the resources they have access to, the economic situations they face, and how these factors interact with natural resources.
- Establishing connections between integrated farming systems that involve several enterprises and the market, as well as value addition, processing, handling, and storage facilities for agricultural goods at the production sites. This aims to provide the livelihood security of small landholders.

#### **DEVELOPMENTAL ISSUES:**

- The primary objective of development initiatives should be to assist farmers in effectively managing their resources in a sustainable manner. The State's scientific land use planning is being developed utilising advanced remote sensing and GIS methods by HARSAC and CCSHAU, Hisar.
  - Encouraging the adoption of agricultural practises and strategies that enhance the organic carbon content of soils.
  - Implementing a targeted initiative to incorporate legume or green manure crops into cereal-cereal cropping systems, either as catch crops or inter/mixed crops.
  - The Department of Agriculture aims to enhance the existing soil health cards by transforming them into a comprehensive "Soil Nutrient Management" system. This initiative places a stronger focus on preserving soil organic matter and promoting overall soil health.
  - Promoting the use of pressurised irrigation systems and other water-saving techniques,
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such as furrow irrigation, raised and sunken beds, fertigation, protected cultivation, and plasticulture, by providing appropriate incentives to farmers, while discouraging flood irrigation.

- Enhancing water resources by preserving rainwater in agricultural fields, underground water sources, bodies of water, combining the use of salty and fresh water, purifying sewage and industrial waste for irrigation purposes, removing sediment from existing bodies of water, and constructing new water storage facilities to address the shortage of water for irrigation.
- Enhancing the capabilities of CCS Haryana Agricultural University, State Department of Agriculture, and Irrigation Department to provide training programmes that emphasise enhanced on-farm water management through the utilisation of contemporary instruments for extension workers, farmers, and other relevant parties.
- We are actively seeking opportunities to enhance our human resources capacity, both in terms of quantity and quality, by collaborating with prestigious international institutions specialising in Natural Resource Management at CCS Haryana Agricultural University, Hisar.

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