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ORIGINAL PAPER

Eastern Himalayan Division: A Potential Zone to be Hub of Agriculture

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ABSTRACT

Eastern Himalayan Division (EHD) has a completely different agro-climatic situation concerning agriculture. This zone is still exempted from the direct benefits of green revolution and commercialized agriculture. The majority of the population is dependent on agriculture and allied land-based activities. Despite several limitations, the zone is rich in untapped natural resources that need to be exploited in a sustainable way which mountain community can embrace. Accordingly, watershed prioritization, conservation measures and alternate land-use systems need to be promoted for traditional food security and income generation. This article marks the characterization and agricultural potential of EHD as a sustainable development strategy under different agro-climatic zones (ACZs').

Keywords: Agro-climatic zone, Eastern Himalayan Division, Food security, Natural resources, Watershed

INTRODUCTION

Agriculture and its output largely depend on the components like climate, soil and landforms. A diverse climatic condition is seen in India, from tropical in the southern parts, the subtropical climate in most of the Northern parts, and temperate climate in North and North-Eastern India including the Himalayan states. This climatic and physiographic heterogeneity gave rise to distinct land use patterns, technological adoptions, and socioeconomic characteristics across the agricultural systems of the

country (Singh et al. 2021). In terms of sustainability, Indian agriculture sector faces a huge challenge considering intensive cropping systems, over-exploitation of natural resources, unpredictable weather patterns and seasonal shifts due to climate change. The Himalayan ecology is rich in natural resources and contributes significantly to maintain the climatic and natural balance of the country. With the increase in human population, forest resource is being exploited both legally and illegally, while local people extensively use fuelwood for cooking and construction purpose. This may potentially destruct the micro-biosphere associated with the forest resources. Moreover, inherent problems of this zone, such as poor infrastructural facilities (irrigation and transportation), difficult terrain, soil degradation and climatic instability led to shifting of many local people to opt for better opportunities to earn the living outside of agriculture. Industrial development such as mining industries and road construction have become secured source of jobs in several parts of this region. These operations led to serious environmental concerns that are mostly beyond monitoring.

Accordingly, agro-climatic zone (ACZ) based specific development is the foremost strategy to enhance the sustainability of the ecosystem. An agro-climatic region is a land unit in terms of major climate and growing period which is climatically suitable for a certain range of crops and cultivars (FAO, 1983). The planning aims at scientific management of regional resources to meet the food, fibre, fodder and fuel wood without adversely affecting the status of natural resources and the environment. The primary objectives while adopting regional assessment should be properly planned and socially accepted, with maintaining ecological balance and economic feasibility at the same time.

AGRO-CLIMATIC ZONES OF INDIA

The 15 broad agro-climatic zones in India were the result of mid-term appraisal of the planning targets of the 7th plan of planning commission, largely based on physiography, soils, geological formation, climate and cropping patterns (Figure 1). The 15 agro-climatic zones are – (1) Western Himalayan division, (2) Eastern Himalayan division, (3) Lower Gangetic plain region, (4) Middle Gangetic plain region, (5) Upper Gangetic plain region, (6) Trans-Gangetic plain region, (7) Eastern plateau and hill region, (8) Central plateau and hill region, (9) Western plateau and hill region, (10) Southern plateau and hill region, (11) East coast plain and hill region, (12) West coast plain and hill region, (13) Gujarat plain and hill region, (14) Western plain and hill region and (15) Island region. The primary objective was to integrate with state and national plans for policy development that aimed at broad agricultural planning and strategic development. The major emphasis was put on resource development and their optimum utilization within the framework of resource constraint and potential of each region (Khanna, 1989). The planning also emphasized on the factors intrinsically related to character of agricultural economy i.e., soil type, climatic conditions (rainfall and temperature), meteorological characteristics, water demand and supply with water quality and aquifer conditions. Most of these efforts were to delineate comparable resource regions, maximize the production from the available resources based on the climatic conditions and transfer

agro-technology to meet the specific zone's need for food, fodder and fibre (Sehgal et al. 1992).

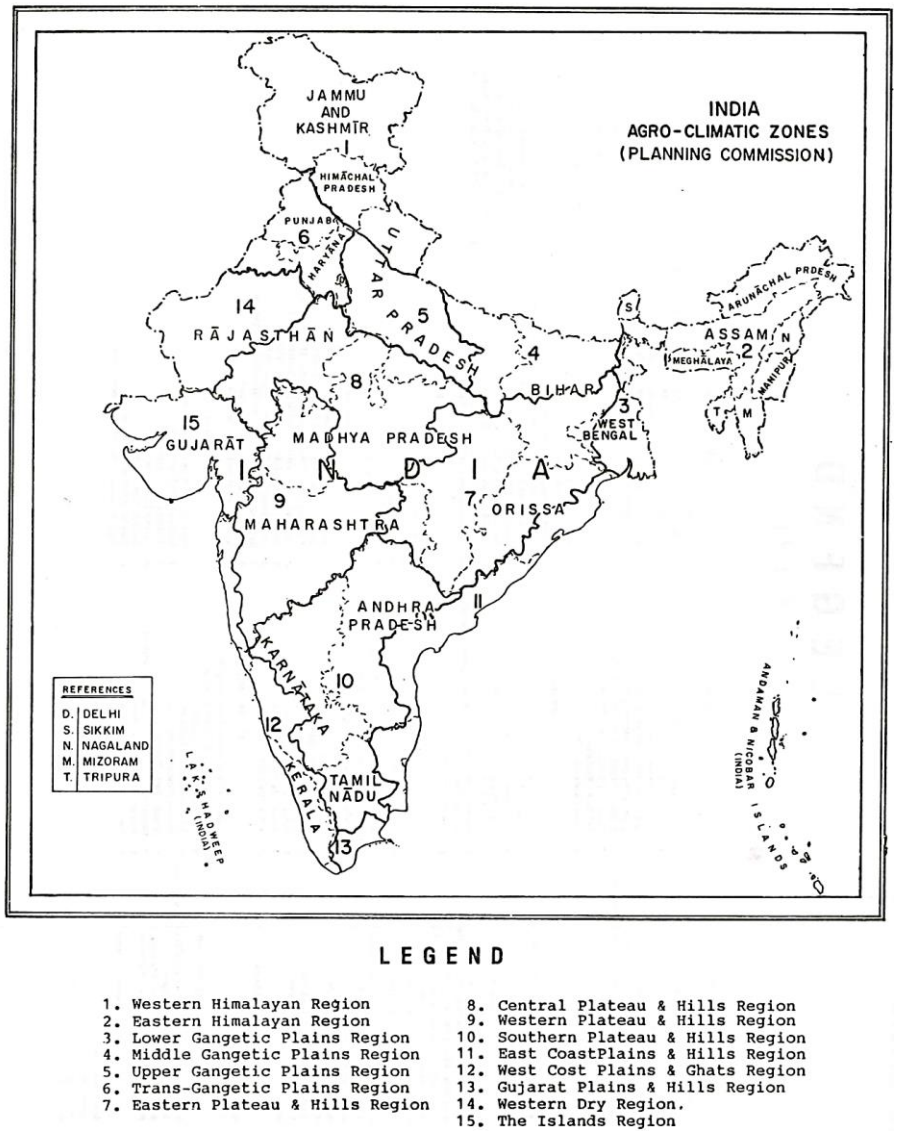

Figure 1. Agro-climatic zones of India (Adopted from Sehgal et al. 1992)

LOCATION OF EASTERN HIMALAYAN DIVISION

Among the 15 ACZs', the Eastern Himalayan Division (EHD) (Figure 2) includes Darjeeling, Cooch Behar and Jalpaiguri districts of West Bengal, Arunachal Pradesh, Assam hills, Sikkim, Meghalaya, Nagaland, Manipur, Mizoram and Tripura. The entire zone can be subdivided into different sub-agro-climatic zones. The Himalayan hills include Darjeeling and the Northern territory of Sikkim. North-East hills include the major areas of Arunachal Pradesh, Nagaland and Meghalaya. Southern hills include Manipur, Tripura and Mizoram. The lower Brahmaputra catchment includes the population-laden districts of Assam i.e., Barpeta,

Dhubri, Nagaon, Darrang, Kamrup, Goalpara, Kokrajhar, Sonitpur etc. and the upper Brahmaputra area comprises Cooch Behar, Jalpaiguri districts of West Bengal and the districts of Lakhimpur, Sibsagar, Cachar, Dibrugarh, Jorhat and Karimganj in Assam.

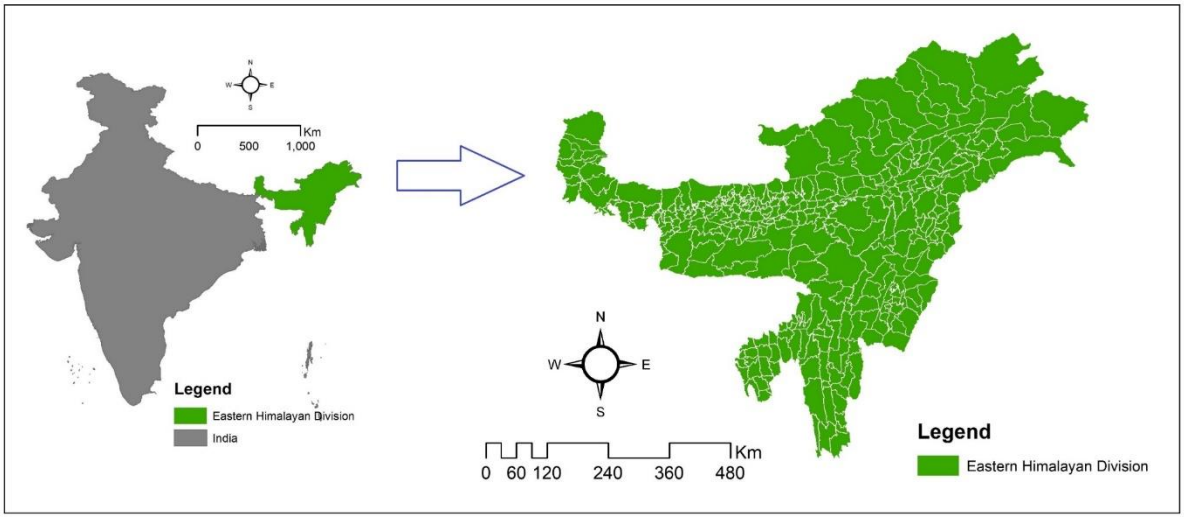

Figure 2. Geographical location of number two agro-climatic zone: Eastern Himalayan Division

PHYSIOGRAPHICAL CHARACTERIZATION OF EASTERN HIMALAYAN DIVISION

Topography and soil

The topography of EHD is rugged. Difficult terrain, wide variation in altitude and slope, diversified land use system and cultivation practices are characteristic features of the region. Brown hilly soils are prevalent in Darjeeling hills of West Bengal and further Northern territory of Sikkim. The soils of Anurachal Pradesh, Nagaland, Meghalaya and Assam (Karbi Anglong and Cachar hills) are classified as red sandy to laterite (Ahmad et al. 2017). The soils of Cooch Behar and Jalpaiguri in West Bengal and upper Brahmaputra valley regions (Lakhimpur, Sibsagar, Cachar, Dibrugarh, Jorhat and Karimganj districts of Assam) are alluvial to red loamy. Soils of Cooch Behar and Jalpaiguri districts are of light to medium in texture (Nayak et al. 2001) and are characterized by sandy loam to silty loam with good drainage facility. Alluvial and red loamy soils are also dominant in the districts of Barpeta, Dhubri, Nagaon, Darrang, Kamrup, Goalpara, Kokrajhar and Sonitpu of Assam. In Meghalaya, soils are deep to very deep in depth, brown to greyish brown in colour, slightly acidic to extremely acidic in reaction and high to medium in organic carbon (Kharlyngdoh et al. 2015).

Climatic description

The zone resides under per-humid to humid climatic conditions. Ahmad et al. (2017) reported the temperature variation in EHD to be between 25 to 30°C in July and between 10 to 20°C in January months. The average annual rainfall is between 200 to 400 cm, however, varied spatially in the lower Brahmaputra catchment (average 1840 mm),

Southern hills region (average 2052 mm), upper Brahmaputra catchment (average 2800 mm) and North-East hilly region (average 3528 mm) (Alam, 2006).

AGRICULTURAL STATUS IN EASTERN HIMALAYAN DIVISION

The agriculture in this entire division is based on locally available natural resources that involve complex linkages among farms, forests and livestock systems (Tiwari and Joshi 2015). This region is unique for diversified land use and agricultural systems.

Cropping and irrigation

The soils (*i.e.,* red-brown soils) of EHD are not highly recommended for intensive cultivation considering the dense forest cover in Himalayan hills. Several North-Eastern states such as Arunachal Pradesh and Nagaland have a low net sown area with 94% and 50% of forest coverage, respectively, out of total land (Lele and Joshi, 2009). Meghalaya has however higher cultivable area, with similar proportions under forests. A huge number of farmers also grow shade tea under residual forest trees. Rice, maize, potato, tea etc. are the major crops grown in sparse cultivable areas under this division (Ahmad et al. 2017). As a staple food, rice occupies 81% of the total area under cereals followed by maize (12.8%) (Alam, 2006). Wheat is cultivated in small areas in Arunachal Pradesh, Meghalaya, Sikkim and Tripura, whereas oilseeds cover 5.6% area under cultivation. Rice-wheat cropping system maintains food security in this region. Cropping systems with diverse crops are also common that include finger millet, maize, red gram, mustard, amaranths, castor, field beans and banana.

The irrigated area in EHD is reported to be 23.42%, with plenty of surface resources and high groundwater potential (Alam, 2006). Rainfed agriculture is primarily carried out, while summer cultivation is also popular with assured irrigation supply. However, in mountain hills, irrigation infrastructure is not well developed due to poor implementation considering the region's inaccessibility. In states like Sikkim serious soil erosion has been reported with faulty irrigation practices.

WATERSHED PRIORITIZATION OF EASTERN HIMALAYAN DIVISION

Himalayan ecology has a significant contribution in maintaining the climatic and ecological balance of the country with its watershed. Watershed degradation is primarily caused by misuse and mismanagement of the land by the population resides within. The land planning is often faulty, without proper irrigation outlets and causes landslips and terrestrial over-exploitation (Teja et al. 2019). The situation is further aggravated due to increased population pressure and non-availability of the arable land. In hilly marginal lands, ploughing is done on steep slopes and across the contour. In sparsely vegetated covered areas overgrazing is practiced in drier months that give rise to the network of rills and gullies. Slash and burn agriculture (shifting cultivation) is still practiced in hill areas where the tribal population lives (Goswami et al. 2012). Shifting cultivation is a dominant economic activity in hilly tracts of Assam, Arunachal Pradesh, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura except for the plains of Cooch Behar, Assam,

Manipur and Tripura (Bhuyan, 2019). All these practices are erosion-promoting and reduce vegetation cover without replenishment. The destruction of erosion-resisting species by locals for fodder purposes further complicated the issue.

Hence, watershed prioritization needs to be adopted by planners and policymakers with consideration of problem prioritization, funds constraint, extent of the catchment area and the manpower demand of the local system (Chung and Lee, 2009). There is a need for better coordination between the agriculture, forest, irrigation, flood control and human resource departments as far as hilly watershed management is concerned. The most needed, therefore, is to channel their energy in the right direction i.e., through participatory watershed management. The whole community need to identify its objectives, find resources to deal with them and develop collaborative attitudes and practices in the community.

AGRICULTURAL POTENTIAL OF EASTERN HIMALAYAN DIVISION

The traditional agricultural practices which are detrimental to soil health cannot be washed away overnight, but smart planning can reduce the ecological ill effects. The present agriculture practices in this zone are low input-intensive and generate lesser yield. Soil quality is also low, such as in Manipur most of the lands were reported to be barren and uncultivable (Kushwaha et al. 2007). Furthermore, cumulative changes in weather conditions (i.e., reduced rainfall, longer summer season) were reflected in observations such as drying up of water bodies and the disappearance of wetlands. These changes have affected the yield of main staple crops and reduced agricultural productivity resulting decline in livelihood security and crop biodiversity in this region.

The key to sustainability is crop diversification. Different types of agroforestry systems that includes mixed horticultural crops (fruits, vegetables, root crops etc.) and perennial trees can utilize untapped natural resources as well as supplement the loss of the associated enterprises. Along with soil and water conservation measures (in-situ and ex-situ), alternate land-use system can improve soil fertility levels, reduce erosion, provide quality water for local consumption, fuel and timber for energy and construction materials and fodder for the livestock. By default, hill agriculture is organic agriculture. To promote this, improved microbiological intervention along with organic-based nutrient supplements should be promoted in this climatic condition. From an economic point of view, the integration of cash crops into the system can give a good financial return that helps poverty alleviation. The trend of using fewer perishable crops like black pepper, cinnamon, cashew nut, coconut etc. is increasing due to handsome foreign exchange and less pressure in creating additional infrastructural facilities (Alam, 2006). Farmers now have adopted new crops and accordingly adjusted the agricultural practices based on planting times, cropping patterns and growing fodder trees. Contextually, infrastructural improvement and agricultural mechanization in terms of superior cultivation techniques can boost both agricultural productivity and profitability in this AER.

CONCLUSION

EHD is rich in natural resources but suffers from poor infrastructural facilities, soil erosion and environmental hazards that undermine the livelihood means of the innate communities. There is a huge gap in terms of achievable and actual yield in this region. ACZ-based land use planning can fill this gap by identifying the potential management zones that can be prioritized and brought under the benefits of agricultural technology transfer. Mountain communities in general, have an innate desire to improve their livelihood and ensure a better future for themselves and their children. Thus, the policymakers also need to take into account human resources as the success rate depends on the extent of small-holding farmers adopting resource conservation technologies. Contextually, strong resource-based planning that takes account of the region's needs and its careful implementation by policymakers can be helpful to ensure food security in this region.

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