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Agro-Climatic Regions of India: Descriptive Study with Special Reference to the Bundelkhand Agro-Climatic Zone (BACZ)

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Abstract – India is a developing country where agriculture is the main occupation in rural areas. About 70 percent of its population depends on agriculture for livelihood and about 68 percent of the population lives in rural areas. Indian agriculture is dependent on the monsoon. There is a positive relationship between agriculture and climate change. The production and productivity of agriculture depends on various aspects such as land size, soil quality degradation, deforestation, pollution and groundwater level decline. In the era of modernization and mechanization, agriculture has changed more in terms of varieties of crops, nature of production, marketing, etc. Unfortunately, climate change has been responsible for reducing agricultural production and productivity resulting in increased poverty and inequality in India.

The Planning Commission has (1) To use practices that help in increasing agricultural production (2) To increase income from agriculture (3) Create more employment opportunities (4) An action plan for scientific and sustainable use of natural resources To provide, keeping in mind the objectives, India has been classified into 15 agro-climatic zones. In this study, Bundelkhand agro-climatic zone (BACZ) located in Uttar Pradesh and Madhya Pradesh has been selected for special study. To control the rapid changes in climatic conditions, plantation in the study area, promotion of water harvesting practices Efforts to give and prevent deforestation are required.

Key Words – Agro-Climate Region, Bundekhand, Climate Change, Regionalization.

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INTRODUCTION

Regionalization has been used for planning at various levels. Depending on the purpose of the study, several methods have been used for regionalization. An important objective of these efforts was to develop agro-ecological regional maps for the country to be used to produce and transfer agro-technology to meet the country's food, fodder and fiber needs.

Most of the early attempts at regionalization were made on the basis of extensive natural areas, existing crop models as well as a broad framework of climate changes on a large scale. Ashok Mitra (1977) divided the country into 7 natural states, 31 sub-territories and 89 divisions. Murthy and Pandey (1978) divided the country into 8 territories based on geomorphology, soil, rain and water balance and agricultural practices. Agro-climate indicators have been used more commonly for this regionalization. The National Commission on Agriculture (1971) classified the country into 127 agro-climatic zones. Planning Commission has adopted agricultural sectors on various parameters of agricultural planning. Bhattacharya (1982) prepared bio-climatic maps based on rainfall and potential evapo-transpiration rate (PET), which affect the biological environment. Krishna (2004) has divided 40 soil climatic regions on the basis of soil type and humidity index. The moisture index was based on Thornthwaite-Mather moisture index (MI) approach (where P is Precipitation):

$$MI = (P - PET) / PET$$

Where, P-precipitation, MI- moisture index, PET-evapo-transpiration rate

Thus 9 climatic classes were superimposed on 13 zone soil maps to evolve 40 soil climatic zones. The basic criticism of this approach was that, although soil types were included in the zonation, however, soils were not classified on the basis of their water retention capacity.

In 1964, the Planning Commission presented its regional classification at the district level on the basis of physical form, topography, geomorphology,

rainfall, crop models, irrigation potential and soil resources.

Experimental programs on agricultural research were initiated by the Indian Council of Agricultural Research (ICAR) in 1979. Under this, 126 agro-climatic zones were determined based on parameters like soil, climate, topography, vegetation, crops etc. The Agricultural Ecological Zones (NBSS and LUP) determined by the National Bureau of Soil Survey and Land Use Planning came up with 20 agro-climatic zones with effective rainfall, soil agglomeration, delineating district boundaries with a minimum number of areas. All 20 agro-climatic zones were subsequently divided into 60 subfields.

Another attempt was made in regionalization under the Planning Commission in 1988 and the country was in 15 agro-climatic regions and was further subdivided into 73 sub-regions. This was agro-climatic classification keeping in mind the suitability of climate for agriculture. In all the efforts made for agro-climatic regionalization, indicators related to agriculture, weather, water resources development as well as other indicators were given importance.

An important result of these efforts was that indicators such as soil, temperature, topography, vegetation geo-hydrology, water, and agricultural technologies were included to determine more extensive agricultural ecological zones.

Agro-Climatic Regions of India

The objective of the Agro-Climate Regional Plan is to make more scientific use of natural and man-made resources in the country. As a first step, the country is divided into 15 territories based on agro-climatic factors - such as soil type, rainfall, temperature and water resources.

The 15 regions so delineated are-

Zone-1: Western Himalayan region

Zone-2: Eastern Himalayan region

Zone-3: Lower Gangetic plain region

Zone-4: Middle - Gangetic plain region

Zone-5: Upper Gangetic plain region

Zone-6: Trans-Gangetic plain plain region

Zone-7: Eastern plateau and hill region

Zone-8: Central plateau and hill region

Zone-9: Western plateau and hill region

Zone-10: Southern plateau and hill region

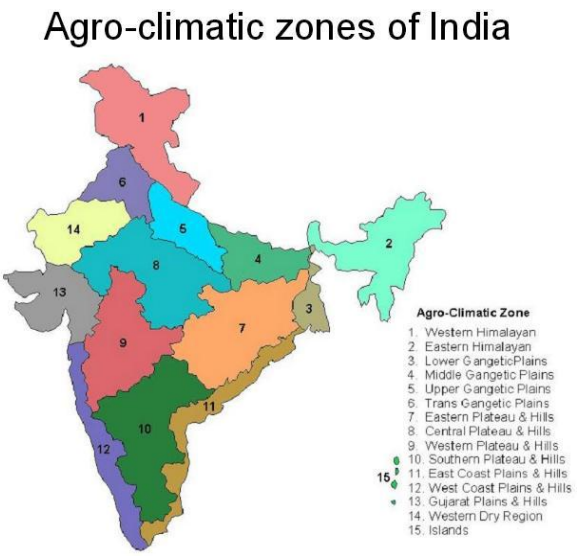
Zone-11: East coast plain and hill region

Zone-12: West coast plain and hill region

Zone-13: Gujarat plain and hill region

Zone-14: Western plain and hill region

Zone-15: Island region

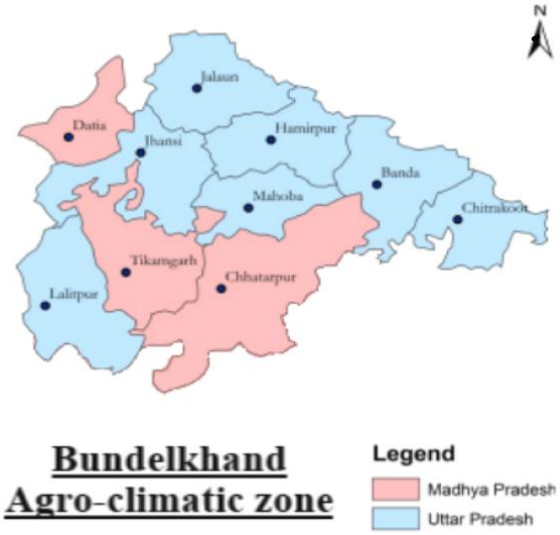


Zone 8 - Central Plateau and Hills Region:

The region is spread over Bundelkhand, Baghelkhand, Bhander Plateau, Malwa Plateau and Vindhyachal hills. The Central plateau and hilly region is a large area comprising 46 districts of Madhya Pradesh, Uttar Pradesh and Rajasthan. The central plateau and the hilly region are further divided into 14 sub-regions based on the diverse topography of hills, mounds, valleys and ravines. About one third of the land in this area is not available for cultivation. The climate varies from dry to sub-humid from west to east. Irrigation intensity and crop intensity are low, and food crops are dominated. By adopting scientific methods like water conservation, crop diversification, ground water development, rainfed agriculture method, appropriate necessary measures can be taken for the development of the region.

Bundelkhand Agro-climatic zone-

The Bundelkhand agro-climatic sub-region consists of ten districts of South Central Uttar Pradesh and North Madhya Pradesh. Which are as follows - Jalaun, Jhansi, Lalitpur, Hamirpur, Mahoba, Chitrakoot and Banda (seven districts of south-central Uttar Pradesh), and Datia, Chhatarpur and Tikamgarh (three districts of North Madhya Pradesh). The sub-region of Uttar Pradesh receives about 900 mm of rainfall, while the sub-region of Madhya Pradesh receives about 700 mm of rain. The climate here is dry and sub-humid. Soil erosion rates are high in this region and land productivity is low. There is wastelands here at about 37% which is proportionately much higher than other area. About 45% of the land is cultivated here. About one third of the agricultural area is irrigated.



BACZ lies between the Gangetic plain in the north and the Vindhya Range in the south. The northern boundary of the Bundelkhand Agro-climatic zone is demarcated by the Yamuna River while the eastern boundary is demarcated by the Ken River. The Kali Sindh River marks the western boundary of the BACZ. This region is a low sloping area with barren mountainous vegetation with sparse vegetation, but it was forested in ancient times. The major rivers flowing in the area are Sindh, Betwa, Shehzad River, Cane, Tigrin, Tons, Pahuj, Dhasanand, Chambal. Yamuna and Ken are the only two navigable rivers.. Notwithstanding the large number of streams, the depression of their channels and height of their banks render them for the most part unsuitable for the purposes of irrigation, which is conducted by means of ponds and tanks.

BACZ is a hot and semi-humid region. The hottest days are May and the coldest days are in December or January. But locally the temperature is very high. The average annual temperature here is more than 25°C. In summer the average temperature is around 30°C and in May - June the temperature goes up to 40°C. Banda is one of the hottest places in India, and many people die from sunstroke here every year. The average annual rainfall is 75 cm to 125 cm from north to southeast. Around 90% of the year is received in the 4 months between June and September. Since time immemorial, the uncertainty and irregularity of rainfall has been more responsible for the large number of famines, droughts and holocaust in this region. Some rainfall is received in winter season, which is highly beneficial for the Rabi crop. This type of rainfall is called 'Mahavat' in the local language.

Over 2500 million years old, granite-like structures are found in the BACZ, called Gneiss and Bundelkhand granite. Most of the rocks in Datia, Jhansi, Lalitpur, Tikamgarh, and Chhatarpur, District and Chitrakoot and Mahoba districts are of granite, which is full of mineral composition. Often, built-in walls prevent the flow of natural streams such as water, creating water bodies and also enabling the creation of large artificial lakes. Extensive limestone deposits are found in Chhatarpur and Datia, while basalt rocks are found in southern Lalitpur. The sand, silt or mud brought by the rivers flowing northward has led to the deposition of the new alluvium.

BACZ is an important source of some of the country's rare mineral deposits. At present, Bundelkhand is more trained for the availability of stones. Jhansi, Lalitpur, Mahoba, Banda, Datia and Chhatarpur districts are famous for varieties of pink, red and brown granite. Two varieties called Jhansi Red and Fortune Red are mined in Chhatarpur which are unique. Excellent sandwork can be done on the soft sandstone found in the area for house construction; An example is the famous sculptures of Khajuraho temple in Chhatarpur district for example. Lalitpur is known for its different varieties of sandstone, of which Lalitpur Gray and Lalitpur Yellow are prominent. Less valuable stones are broken and used for road and building construction. The most valuable resource of UP Bundelkhand is the silica sand found in Mau tehsil of Chitrakoot. This deposit is considered the best source of glass sand in India. Lalitpur is important for low grade iron ore as well as rock phosphate which is an essential part of the fertilizer industry. Datia and Tikamgarh districts provide essential soil in various industries. Early pebbles found in some places in the Ken River gravel are used to make artifacts and trinkets.

Several rivers of Yamuna river system flow in BACZ. The major rivers flowing in this region are Yamuna in the north, Cane in the east and Betwa and Pahuj in the west. The river Yamuna flows from west to east and its first order tributaries - Betwa, Ken, Pahuj, Baghin and Paisuni flow from south to north. Several other tributaries of Yamuna like Dhasan, Jamni, Birma, Sonar, Katne, Bewas, and Kopra dry the region. Apart from this, there are Sindh and

Chambal rivers flowing in the west. The Bundelkhand Upland and Bundelkhand Plains sub-region receives about 50% of the water by the Betwa River and about 25% of the water by the Ken River. Both the Betwa and Ken rivers flow through both the UP and MP states. Betwa, Cane, Pahuj and Dhasan are important for irrigation in BACZ. However, seasonal fluctuations in these rivers are very high. For example, the average annual discharge of the Cane River is about 800 cusecs, but in winter it is about 300 cusecs and decreases to practically nothing in May. Such fluctuations undermine the safety of irrigation for agriculture. A study of the status of water carried out in 131 villages of UP's BACZ found that only 7% of the villages had sufficient water to meet household needs throughout the year. In more than 60% of the villages, drinking water was available for only one month. In the entire BACZ region, women have to work hard for about 4-5 hours per day to collect water. Whereas according to the chapter, 9% of the women in the village have to go more than 4 kilometers for water. Under such conditions of uncertain water supply in rivers, it is necessary to adopt practices of water conservation techniques such as tanks, ponds, bawdio, rainwater harvesting to maintain irrigated agriculture and provide protection to farmers. The need for water harvesting in the area was recognized since ancient times. BACZ is known for its water bodies including Pahuj Reservoir, Barwasagar, Barwarlake, Aiyori Lake, Pachwara Lake, Dakavan and Paricha Reservoir. A wide range of small tanks and ponds (talas) are found near Mahoba. Tikamgarh also has lakes like Madansagar, Nandwara, Birsnagar and Arjan. Among the important tanks in Chhatarpur district are Jagatsagar, Gortal, Gangau reservoir, Mattila, Lalitpur and Saprar reservoir.

The total population of BACZ is around 13.6 million (Census 2011). While 79% of the population lives in rural area. In recent years, due to lack of employment and lack of opportunities in this area, the poverty situation has become serious. It has a reason. The largest population is in Jhansi (19.9 lakh) and the least in Datia district (7.8 lakh). Whereas less than 10% of the population in Chitrakoot lived in urban areas. There is a clear variation in the inter-regional distribution of the population. Bundelkhand plains have high population density while plateau region has low population density. However, BACZ has seen high population growth in recent decades.

BACZ is one of the poorest regions not only in Uttar Pradesh (UP) and Madhya Pradesh (MP), but in the whole of India. Agriculture is the basic occupation of rural people and forms the basis of rural economy. A small section of the rural population depends on non-agricultural occupations such as carpentry, pottery, basketry, etc. But these businesses are also indirectly dependent on agriculture. The number of days of rain in BACZ has come down from 52 to 24 (IMD). Due to uncertainty and irregularity of the year in the region, agriculture has to face the problem of drought every year. Agricultural crops or various other livelihoods such as fishing,

BACZ is an arid region where agriculture depends heavily on the monsoon. In recent times, dams have been constructed to provide water for irrigation. Here the kharif crop is rainfed. Peas, groundnut, spleen, gram, maize, urad, moong, millet are the major crops along with wheat in irrigated areas. Uncontrolled grazing by stray animals (Anna system) is a major problem in the area. The wells were part of the Bundelkhand culture and were considered sacred places, but in the present times this trend has ended, due to which the problem of water in this area is becoming more and more difficult. A large number of lakes and embankments were built here in the medieval period by the Chandela and Bundela kings, but at present these structures are either destroyed or on the verge of destruction due to lack of maintenance.

Proper irrigation system is the most effective mitigation strategy to ensure agricultural production. In BACZ, agriculture is the most important activity for the livelihood of the people and several major and minor irrigation schemes are being operated in Bundelkhand to provide irrigation water to the farmers. However their success is insignificant compared to the serious socio-economic needs of the region.

Due to lack of rainfall and crop up of crops, employment of seasonal agricultural laborers who were now forced to migrate to Delhi or Punjab. According to the report of the Migration Society's Internal Committee, so far more than 62 lakh farmers have migrated from BACZ due to starvation and drought tragedy and four thousand farmers have committed suicide in indebtedness.

Sr. No.	District	Migrate Population
1	Bandha	737920
2	Chitrkut	344801
3	Mahoba	297547
4	Hamirpur	417489
5	Jalon	538147
6	Jhansi	558377
7	Lalitpur	381316
8	Tikamghar	589371
9	Chhatarpur	766809
10	Datia	200901
	Total	**4451362**

Sources- Internal Committee of the Migration Society

CONCLUSION

In conclusion, The concept of Agro-Climate Region was brought with the following objectives in mind–

- is needed to optimize agricultural production.
- Increase farm income
- create more employment opportunities
- Provide a Framework for Scientific and sustainable use of natural resources.

BACZ is an area which is always in the headlines due to drought, crop wastage, fodder shortage, animal deaths, farmer suicides, economic migration etc. Therefore, a regional development strategy should be formulated keeping in view the agro-climatic conditions for the development of the region.

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