

Agro-climatic Regions of India

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Agro-climatic Regions of India

Introduction:

Regionalisation has been used for planning at various levels. Several methodologies have been used for regionalisation depending on the purpose and ends. An important objective of most of these efforts was to evolve agro-ecological regional maps for the country in order to delineate comparable resource regions, for generating and transferring agro-technology to meet the country's needs of food, fodder and fibre. Most early attempts at regionalisation were on the basis of broad natural regions, existing cropping patterns, as well as a broad framework of climatic variations at a macro scale.

Mitra (1977) divided the country into 7 natural regions, 31 sub regions and 89 divisions. Murthy and Pandey (1978) demarcated the country into 8 regions on the basis of physiographic, soils, rainfall and water balance, and agricultural practices. This regionalisation suffered from too much generalization and over-emphasis on agro-climatic indicators. National commission on agriculture (1971) classified the country into 127 agro-climatic zones. The planning commission has adopted agricultural Zones on the various parameters for agricultural planning. They prepared bio-climatic maps on the basis of rainfall and potential evapo-transpiration (PET) values, which influence the biotic environment. Krishna (2004) prepared 40 soil climatic zones (areas falling in the same climate and water balance class and having similar soil types) on the basis of soil types and moisture index. The moisture index was based on Thornthwaite-Mather moisture index (MI) approach (where P is Precipitation):

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

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 based its regionalisation on physical conditions, topography, geomorphology, rainfall, cropping pattern, development of irrigation and land resources at the district level.

The launching of the National Agricultural Research Project in 1979 by the Indian Council of Agricultural Research (ICAR) initiated experimental programmes on agricultural research. Agro climatic zonation or ecological land classification was undertaken on the basis of parameters like soils, climate, topography, vegetation, crops etc. for delineation of 126

zones. The National Bureau of Soil Survey and Land Use Planning (NBSS-LUP) made a comprehensive attempt at agro-ecological regionalisation and the country was divided into 20 regions following the FAO methodology of sequential layering of information on maps (NBSS Publication, 1992). The regions were aggregated on the basis of uniform climatic factors, physiography, natural vegetation, soils and length of growing period. The major emphasis of this regionalisation was on the bio-climatic factors and length of growing period.

In 1988 under the Planning Commission another attempt at regionalisation was made and the country was divided into 15 agro-climatic regions with 73 sub-regions. It was nothing but an extension of the climate classification keeping in view the suitability to agriculture.

In all the attempts at agro-climatic zoning, although importance was given to other indicators, greatest emphasis was given to the inherent commonality of the agro-meteorological indicators and water resources development. An important outcome of these exercises was that a need was felt by several scholars and organizations to include parameters like soils, temperature, topography, vegetation geo-hydrology, water and farm technologies in order to have more comprehensive agro ecological zoning.

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In 1988 the Planning Commission came up with a growth strategy based on a holistic approach of area planning for long-term resource efficiency and sustainability. The motivation behind this was that resource based planning became feasible once homogeneous regions with respect to natural resource endowments (agro-climatic factors) were delineated and their utilization of available natural resource endowments was related to requirements of output and employment. During the late nineteen eighties, a consensus seemed to have been achieved on the primacy of topography for a regional division of India. Based on this notion the Planning Commission delineated 15 agro-climatic zones; there still existed wide variation in geographical area, population density, soil types and crops grown. To increase the degree of homogeneity in agro climatic factors, these 15 zones were further sub-divided into 73 sub-zones based on more specific soil types, topography, climate and cropping pattern characteristics.

A planning team was set up for each zone and each zone was sub-regionalised on the basis of factors intrinsically related with the character of the agricultural economy. These included soil type, climate (temperature, and rainfall and its variation), relevant meteorological characteristics, water demand and supply, including quality of water and

aquifer conditions. It was also decided that, at this stage, it was better to concentrate on agro-climatic characteristics, and to not bring in other social and administrative criteria for regionalisation (Government of India, 1988). Though other features like land holding, workforce, population, employment, living standards were considered for the process of building up of systematic computer compatible data sets, the major emphasis was on agricultural development levels and trends. These regionalisation methods over-emphasize the importance of physiographic divisions and administrative boundaries. Water balance analysis, soil water retention capacity for crop potential, and land capability mapping/carrying capacity estimation were not incorporated in this regionalisation.

This identification of agro-climatic zones for the purpose of developing location specific research and development strategies for increasing agricultural production has been given the due impetus recently. In order to plan agricultural activities more accurately each region into sub regions based on soil, climate (temperature), rainfall and other agro-meteorological characteristics. Planning Commission has demarcated the geographical area of India into 15 agro-climatic regions. These are further divided into more homogeneous 72 sub-zones.

The main objectives of agro-climatic regions are:

- (i) to optimise agricultural production;
- (ii) to increase farm income;
- (iii) to generate more rural employment;
- (iv) to make a judicious use of the available irrigation water;
- (v) to reduce the regional inequalities in the development of agriculture.

The 15 agro-climatic zones are:-

Zone 1- Western Himalayan Region: Jammu and Kashmir, Uttar Pradesh

Zone 2 - Eastern Himalayan Region: Assam, Sikkim, West Bengal and all North-Eastern states

Zone 3 - Lower Gangetic Plains Region: West Bengal

Zone 4 - Middle Gangetic Plains Region: Uttar Pradesh, Bihar

Zone 5 - Upper Gangetic Plains Region: Uttar Pradesh

Zone 6 - Trans-Gangetic Plains Region: Punjab, Haryana, Delhi and Rajasthan

Zone 7 - Eastern Plateau and Hills Region: Maharastra, Uttar Pradesh, Orissa and West Bengal

Zone 8 - Central Plateau and Hills Region: MP, Rajasthan, Uttar Pradesh

Zone 9 - Western Plateau and Hills Region: Maharastra, Madhya Pradesh and Rajasthan

Zone 10 - Southern Plateau and Hills Region: Andhra Pradesh, Karnataka, Tamil Nadu

Zone 11 - East Coast Plains and Hills Region: Orissa, Andhra Pradesh, Tamil Nadu and Pondicherry

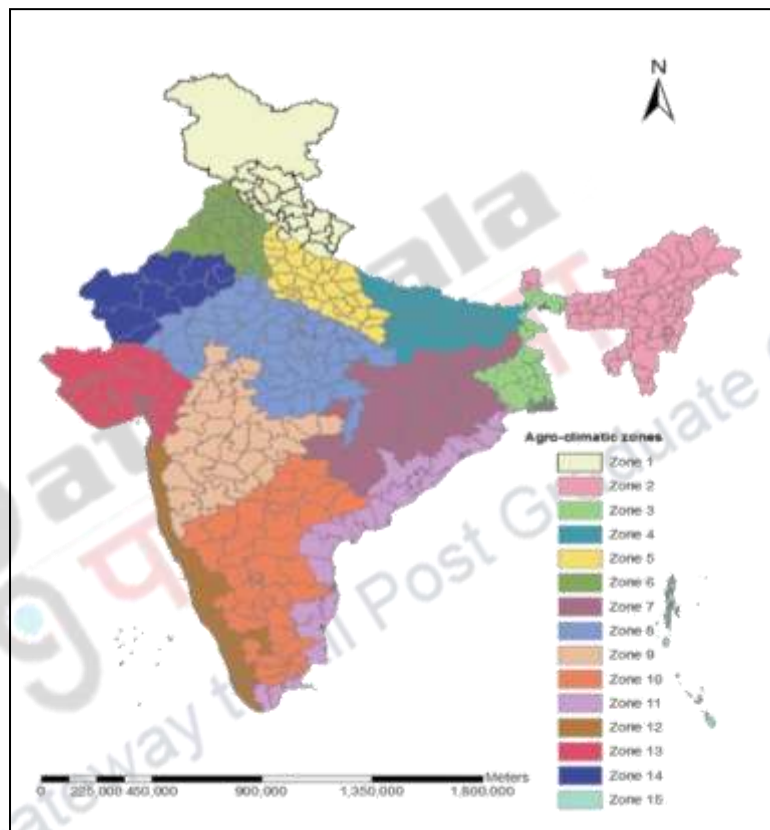
Zone 12 - West Coast Plains and Ghat Region: Tamil Nadu, Kerala, Goa, Karnataka, Maharashtra

Zone 13 - Gujarat Plains and Hills Region: Gujarat

Zone 14 - Western Dry Region: Rajasthan

Zone 15 - The Islands Region: Andaman and Nicobar, Lakshadweep. (Map 1)

Map 1
Agro-Climatic Zones of India



Zone 1- Western Himalayan Region:

It includes Jammu and Kashmir, Himachal Pradesh and Kumaun-Garhwal areas of Uttaranchal. It shows great variation in relief. Summer season is mild (July average temperature 5°C-30°C) but the winter season experiences severe cold conditions (January temperature 0°C to -4°C).

The amount of average annual rainfall is 150 cms. Zonal arrangement in vegetation is found with varying height along the hill slopes. Valleys and duns have thick layers of alluvium while hill slopes have thin brown hilly soils.

The region is gifted with a number of perennial streams due to high rainfall and snow-covered mountain peaks of which Ganga, Yamuna, Jhelum, Chenab, Satluj and Beas etc. are worthy of mention. These provide irrigation water to canals and cheap hydel power for agriculture and industries.

In recent years the increasing human interference has led to the deterioration of the ecological system. Rapid construction activities in the form of buildings and transport routes and unscrupulous mining have led to the depletion of vegetal cover making the area prone to landslides, pollution, receding glaciers and water scarcity.

Rice is the main crop of this region which is cultivated in terraced fields along the hill slopes. Maize, wheat, potato, barley are other important crops. Temperate fruits like apple and pear etc. are produced in some parts of Jammu and Kashmir and Himachal Pradesh. Similarly tea plantations have started in some areas of Garhwal-Kumaun hills.

The horticulture of the region is obsessed with the problems of financial crisis, long gestation period, lack of improved varieties of plants and high post-harvest losses (about 20% in packing, storage, marketing and processing). This needs improvement in old unproductive orchards using the recent technique of grafting, introduction of new fast growing varieties of plants and development of infrastructural facilities. Environmental conditions of this region are well suited for the development of garden and plantation crops.

A more rational land use planning is required for the region. Land suitable for agriculture, horticulture, pasture, forestry respectively should be demarcated on the following basis:

- (a) agriculture on land of up to 30 per cent slopes;
- (b) land having 30-50 per cent slopes for horticulture/fodder development; and
- (c) all lands above 50 per cent slopes under tree cover. Better quality planting material should be made available to fruit growers. The region has favourable climatic conditions for growing temperate vegetables, flowers, and crops like ginger and saffron.

Zone 2 - Eastern Himalayan Region:

The Eastern Himalayan region consists of Sikkim, Darjeeling area (West Bengal), Arunachal Pradesh, Assam hills, Nagaland, Meghalaya, Manipur, Mizoram and Tripura. It is characterised by rugged topography, thick forest cover and sub-humid climate (rainfall over 200 cm; temperature July 25°C-33°C, January 11°C-24°C). The soil is brownish, thick layered and less fertile. Shifting cultivation (Jhum) is practised in nearly 1/3 of the cultivated

area and food crops are raised mainly for sustenance. Rice, potato, maize, tea and fruits (orange, pine-apple, lime, lichi etc.) are the main crops. The ecological system of the region is problematic.

The region needs marked improvement in infrastructural facilities to accelerate the pace of development. Soil degradation should be arrested by controlling deforestation and by terracing in hills. The run-off should be checked and water conserved should be utilised in minor irrigation. Shifting cultivation should be controlled by encouraging permanent settlement. A programme to grow fruits above 30% slopes in the hills needs to be framed. Supporting activities of sericulture, handicrafts poultry, and piggery etc. should be promoted. A long term quality seed production plan should be implemented to assure adequate supply of quality seeds to the farmers

Zone 3 - Lower Gangetic Plains Region:

This region spreads over eastern Bihar, West Bengal and Assam valley. Here average amount of annual rainfall lies between 100 cm-200 cm. Temperature for July month varies from 26°C-41°C and for January month 9°C-24°C.

The region has adequate storage of ground water with high water table. Wells and canals are the main source of irrigation. The problem of water logging and marshy lands is acute in some parts of the region. Rice is the main crop which at times yields three successive crops (Aman, Aus and Boro) in a year. Jute, maize, potato, and pulses are other important crops. Planning strategies include improvement in rice farming, horticulture (banana, mango and citrus fruits), pisciculture, poultry, livestock, forage production and seed supply. An export processing zone for marine and sea foods needs to be established which should be equipped with modern facilities of freezing, canning, dehydration, and quality control.

Organisational set-up for implementation should include:

- (a) a committee at the State level to guide and monitor implementation;
 - (b) the Zila Parishads at the district level; and
 - (c) a village level committee under the aegis of the Panchayat backed by trained staff
- (Wadia, 1996, p. 96).

Zone 4 - Middle Gangetic Plains Region:

It incorporates eastern Uttar Pradesh and Bihar (except Chotanagpur plateau). It is a fertile alluvial plain drained by Ganga River and its tributaries. The average temperature of July month varies from 26°C- 41°C and that of January month 9°C-24°C. The amount of annual

rainfall lies between 100 cm and 200 cm. The region has vast potential of ground water and surface runoff in the form of perennial rivers which is utilised for irrigation through tube wells, canals and wells. Rice, maize, millets in, kharif, wheat, gram, barley, peas, mustard and potato in rabi are important crops.

The agricultural strategy included introduction of modern market oriented agriculture in place of the traditional one. Efforts should be made to improve and stabilise yield of kharif paddy which accounts for over 40 per cent of gross cropped area in the region. Similarly increasing maize production, replacing upland paddy and millets with fruits, vegetables and kharif pulses (Arahar), encouraging pre-kharif paddy (January to June) or maize in low lands, improving low land cultivation through water harvesting structures and alternative farming systems, and utilising chaur lands for pisciculture are some other suggested measures to boost up agricultural production.

The strategy also includes reclamation of 5.5 lakh ha of usar lands, 25.4 lakh ha of wastelands, and 16.5 lakh ha of fallow lands for agriculture and allied activities (agro-forestry, silviculture, floriculture etc.). Supplementary measures should include input delivery system, demonstration of recommended package of practices, particularly for kharif paddy, diversification of crops like vegetables and fruits, and provisions of processing and marketing facilities, poultry, dairying and inland riverine fishery.

Zone 5 - Upper Gangetic Plains Region:

This region encompasses central and western parts of Uttar Pradesh. The climate is sub-humid continental with July month's temperature between 26°-41°C, January month's temperature between 7°- 23°C and average annual rainfall between 75 cm- 150 cm. The soil is sandy loam. It has 131 per cent irrigation intensity and 144 per cent cropping intensity. Canal, tube well and wells are the main source of irrigation. This is an intensive agricultural region where in wheat, rice, sugarcane, millets, maize, gram, barley, oilseeds, pulses and cotton are the main crops.

Besides modernising traditional agriculture the region needs special focus on dairy development and horticulture. Strategies should include developing multiple mixed cropping patterns like rice-potato- wheat-moong and sugarcane , sunflower, and potato + mustard; improving irrigation system and water management such as lining of canals to check seepage; reclaiming saline/alkaline soils; raising fruit trees on Diara areas; devoting uplands to horticulture; improving cattle breed and bringing more areas to fodder crops.

Zone 6 - Trans-Gangetic Plains Region:

The Trans Ganga Plain consists of Punjab, Haryana, Delhi, Chandigarh and Ganganagar district of Rajasthan. The climate has semiarid characteristics with July month's temperature between 26°C and 42°C, January temperature ranging from 7°C to 22°C and average annual rainfall between 70 cm and 125 cm. Private tube wells and canals provide principal means of irrigation. Important crops include wheat, sugarcane, cotton, rice, gram, maize, millets, pulses and oilseeds etc.

The region has the credit of introducing Green Revolution in the country and has adopted modern methods of farming with greater degree of mechanisation. The region is also facing the menacing problem of water logging, salinity, alkalinity, soil erosion and falling water table. The suggested strategies include:

- (a) diversion of 5 per cent of rice-wheat area to other crops like maize, pulses, oilseeds and fodder,
- (b) development of genotypes of rice, maize and wheat with inbuilt resistance to pests and diseases,
- (c) promotion of horticulture besides pulses like tur and peas in upland conditions,
- (d) cultivation of vegetables in the vicinity of industrial clusters,
- (e) supply of quality seeds of vegetables and planting material for horticulture crops,
- (f) development of infrastructure of transit godowns and processing to handle additional fruit and vegetable production,
- (g) implementation of policy and programmes to increase productivity of milk and wool, and
- (h) development of high quality fodder crops and animal feed by stepping up area under fodder production by 10 percent (Wadia 1996, p. 100).

Zone 7 - Eastern Plateau and Hills Region:

It comprises the Chotanagpur plateau Rajmahal hills, Chhattisgarh plains and Dandakaranya. The region enjoys 26°C-34°C of temperature in July, 10°C-27° C in January and 80 cm-150 cm of annual rainfall. Soils are red and yellow with occasional patches of laterites and alluviums.

The region is deficient in water resources due to plateau structure and non-perennial streams. Rainfed agriculture is practised growing crops like rice, millets, maize, oilseeds, ragi, gram and potato. The region requires planning to maximise use of rainwater, increase in

ground water potential, change cropping pattern to achieve a balanced crop production and strengthen input and services delivery systems,

Suggested strategies include:

- (a) coverage of large areas with quality seeds of HYV,
- (b) cultivation of high value crops of pulses like tur, groundnut and soyabean etc. on upland rained areas,
- (c) growing crops like urad, castor, and groundnut in kharif and mustard and vegetables in irrigated areas,
- (d) improvement of indigenous breeds of cattle and buffaloes,
- (e) rehabilitation of 30 per cent of degraded forest lands,
- (f) extension of fruit plantations,
- (g) renovation including desalting of existing tanks and excavation of new tanks,
- (h) reclamation of 95.32 lakh ha of acidic lands through lime treatment,
- (i) development of inland fisheries in permanent water bodies, and
- (j) adopting integrated watershed development approach to conserve soil and rain water.

Zone 8 - Central Plateau and Hills Region:

This region spreads over Bundelkhand, Baghelkhand, Bhandar plateau, Malwa plateau and Vindhya hills. The climate is semi-arid in western part to sub-humid in eastern part with temperature in July month 26°C-40°C, in January month 7°C-24°C and average annual rainfall from 50 cm- 100 cm. Soils are mixed red, yellow and black growing crops like millets, gram, barley, wheat, cotton, sunflower, etc.

The region has dearth of water resources. The suggested measures should include water conservation through water saving devices like sprinklers and drip system; dry farming popularisation; dairy development, crop diversification, ground water development, diversion of 16 lakh ha of low value crops to high value crops, reclamation of ravine lands and improvement in indigenous breed cattle.

Zone 9 - Western Plateau and Hills Region:

This comprises southern part of Malwa plateau and Deccan plateau (Maharashtra). This is a region of the regard soil with July temperature between 24°C-41 °C, January temperature between 6°C- 23°C and average annual rainfall of 25 cm-75 cm. Net sown areas is 65 per cent and forests occupy only 11 per cent. Only 12.4 per cent area is irrigated. Jowar, cotton,

sugarcane, rice, bajra, wheat, gram, pulses, potato, groundnut and oilseeds are the principal crops. The area is known for its oranges, grapes and bananas.

Since the region is deficient in water resources attention be paid to increasing water efficiency by popularizing water saving devices like sprinklers and drip system. The lower value crops of jowar, bajra and rainfed wheat should give way to high value oilseeds like sunflower, safflower and mustard. Five per cent area under rainfed cotton and jowar could be substituted with fruits like ber, pomegranate, mango and guava, appropriate marketing, storage and processing infrastructure to handle added fruit production should be developed. Improvement of milk production of cattle and buffalo through cross-breeding along with poultry development should be taken care of.

Zone 10 - Southern Plateau and Hills Region:

It incorporates southern Maharashtra, Karnataka, western Andhra Pradesh and northern Tamil Nadu. The temperature of July month lies between 26°C to 42°C, that of January month between 13°C-21°C with annual rainfall between 50 cm-100 cm.

The climate is semi-arid with only 50 per cent of area cultivated, 81 per cent of dry land farming, and low cropping intensity of 111 per cent. Low value cereals and minor millets predominate. Coffee, tea, cardamom and spices are grown along the hilly slopes of Karnataka plateau. Suggested strategies include:

- (a) diversion of 20 per cent of area under jowar/bajra/ragi to groundnut/sesamum/sunflower,
- (b) cultivation of soyabean/ safflower on residual moisture after rice,
- (c) development of horticulture,
- (d) restoration of tank irrigation by taking appropriate measures of deepening, embanking etc.,
- (e) use of water saving devices like sprinklers and drip system,
- (f) development of location specific dry land farming technology, viz. early fertilizer responsive varieties of jowar and rice, and
- (g) implementation of programmes for poultry farming and dairy development.

Zone 11 - East Coast Plains and Hills Region:

This region includes the Coromandel and Northern Circar coasts. Here climate is sub-humid maritime with May and January temperatures ranging from 26°C-32°C and 20°C-29°C

respectively and annual rainfall of 75 cm-150 cm. The soils are alluvial, loam and clay facing the menacing problem of alkalinity.

The region accounts for 20.33 per cent of rice and 17.05 per cent of groundnut production of the country. Main crops include rice, jute, tobacco, sugarcane, maize, millets, groundnut and oilseeds. Main agricultural strategies include improvement in the cultivation of spices (pepper and cardamom) and development of fisheries. These involve increasing cropping intensity using water-efficient crops on residual moisture, discouraging growing of rice on marginal lands and bring such lands under alternate crops like oilseeds and pulses; diversifying cropping and avoiding mono-cropping; developing horticulture in upland areas; increasing marine, brackish water and inland fisheries; upgrading genetic potential of existing animals; improving tank irrigation by desalting and embanking existing tanks and improving field channels and structures; and providing solutions to the problems of water logging and alkalinity.

Zone 12 - West Coast Plains and Ghats Region:

This region extends over the Malabar and Konkan coasts and the Sahyadris and is covered by laterite and coastal alluvials. This is a humid region with annual rainfall above 200 cm and average temperatures of 26°C-32°C in July and 19°C-28°C in January. Rice, coconut, oilseeds, sugarcane, millets, pulses and cotton are the main crops. The region is also famous for plantation crops and spices which are raised along the hill slopes of the Ghats.

The strategies include development of high value crops and fisheries, protection of land from salinity ingress and provision of drainage improvement. A programme to sink about 5 lakh dug wells and shallow wells should be undertaken on priority basis.

The approach of homestead system of reclaiming and using Khar lands be accepted, planned and implemented. Low productivity areas of paddy and millets under rained conditions should be diverted to horticultural crops like mango, banana, coconut etc. to cover about 0.5 lakh ha. Appropriate infrastructure for fruit marketing and processing should be developed. Increasing mechanised fishing boats for deep sea fishing, strengthening of cold storage, processing, and transport infrastructure in corporate/cooperative sector, and providing incentives for prawn culture in brackish water should be taken up.

Zone 13 - Gujarat Plains and Hills Region:

This region includes Kathiawar and fertile valleys of Mahi and Sabarmati rivers. It is an arid an semi-arid region with average annual rainfall between 50 cm-100 cm, and monthly

temperature between 26°C-42°C in July and 13°C-29°C in January. Soils are regur in the plateau region, alluvium in the coastal plains, and red and yellow soils in Jamnagar. Groundnut, cotton, rice, millets, oilseeds, wheat and tobacco are the main crops. It is an important oilseed producing region.

The major thrust of development in the region should be on canal and ground water management, rain water harvesting and management, dry land farming, agro-forestry development, wasteland development and developing marine fishing and brackish/back-water aquaculture in coastal zones and river deltas.

Zone 14 - Western Dry Region:

It comprises western Rajasthan west of the Aravallis. It is characterised by hot sandy desert, erratic rainfall (annual average less than 25 cm), high evaporation, contrasting temperature (June 28°C- 45°C, and January 5°C-22°C), absence of perennial rivers, and scanty vegetation.

Ground water is very deep and often brackish. Famine and drought are common features. Land-man ratio is high. Forest area is only 1.2 per cent. Land under pastures is also low (4.3 per cent). Cultivable waste and fallow lands account for nearly 42 per cent of the geographical area. Net irrigated area is only 6.3 per cent of net sown area which is 44.4 per cent of the geographical area. Bajra, jowar, and moth are main crops of kharif and wheat and gram in rabi. Livestock contributes greatly in desert ecology.

Agricultural development strategies include completion of on-going irrigation projects; making research on the use of saline water; popularising bajra varieties giving higher biomass; promoting use of fertilisers; making improved seeds available to farmers, constructing moisture (rain water) conservation structures; increasing yield level of fruits like date palm, water-melon and guava; adopting high quality germ-plasm in cattle to improve their breed; and adopting silvi-pastoral system over wastelands through aerial and manual seeding.

Zone 15 - The Islands Region:

The island region includes Andaman-Nicobar and Lakshadweep which have typically equatorial climate (annual rainfall less than 300 cm the mean July and January temperature of Port Blair being 30°C and 25°C respectively). The soils vary from sandy along the coast to clayey loam in valleys and lower slopes.

The main crops are rice, maize, millets, pulses, areca nut, turmeric and cassava. Nearly half of the area is under coconut. The area is covered with thick forests and agriculture is a backward stage. The main thrust in development should be on crop improvement, water management and fisheries. Improved variety of rice seeds should be popularised so as to enable farmers to take two crops of rice in place of one. For fisheries development multi-purpose fishing vessels for deep sea fishing should be introduced, suitable infrastructure for storage and processing of fish should be built up, and brackish water prawn culture should be promoted in the coastal area.

Conclusions:

The ACRP approach presented the evolution of an innovative planning exercise encompassing several challenges such as geographical units of disaggregation, agricultural planning involving crop, husbandry and allied sectors, priorities of planning process viz profiles, programme strategies, implementation and documentation, integration of organizational and financial resources at all levels of aggregation and interfacing planning needs and priorities at micro-level with the district, state and national levels.

This approach therefore, presented a holistic view and tried to strike a balance between the decentralised planning and resource planning approaches. Moreover it replaced the conventional wisdom of planning in seeking the resources first to meet the felt needs with the innovative approach of planning the available resources and technologies to match the felt needs.

On the whole, as the planning process in India adjusts to liberalisation at macro level and the Panchayati Raj institutions on the ground, ACRP can progress steadily beyond its present status of an experimental exercise provided it makes judicious use of the links with the implementing agencies and rapport with the state governments.