Agronomy – definition – meaning and scope. Agro-climatic zones of India and Tamil Nadu – Agro ecological zones of India

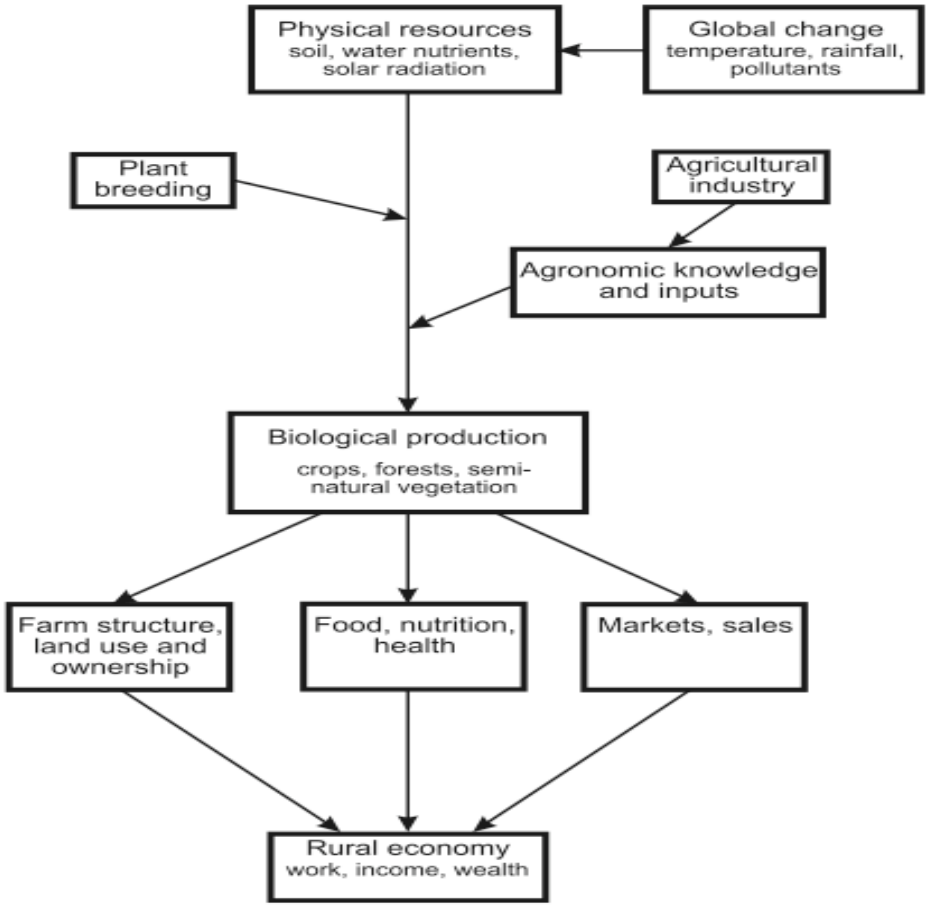
Agronomy is derived from a Greek word '**agros'** meaning 'field' and '**nomos'** meaning 'management'. Principles of agronomy deal with scientific facts in relations to environment in which crop are produced.

Definition of Agronomy

1. It is defined as an agricultural science deals with principles and practices of crop production and field management.
2. Agronomy is branch of agricultural science, which deals with principles, & practices of soil, water & crop management.
3. It is branch of agricultural science that deals with methods which provide favorable environment to the crop for higher productively,

Boundaries and scale

Crop management, and its scientific study agronomy, are part of a system that comprises the physical elements of the climate, soil and land, the biological constituents of the vegetation and soil, the economic opportunities and constraints of markets, sales and profit, and the social circumstances and preferences of those who work the land.



Flow diagram of physical, biological, economic and social dimensions of agronomy

Scope of Agronomy

Agronomy is a dynamic discipline with the advancement of knowledge and better understanding of planet, environment and agriculture. Agronomy science becomes imperative in Agriculture in the following areas.

- Identification of proper season for cultivation of wide range of crops is needed which could be made possible only by Agronomy science.
- Proper methods of cultivation are needed to reduce the cost of cultivation and maximize the yield and economic returns.
- Availability and application of chemical fertilizers has necessitated the generation of knowledge to reduce the ill-effects due to excess application and yield losses due to the unscientific manner of application.
- Availability of herbicides for control of weeds has led to development for a vast knowledge about selectivity, time & method of its application.
- Water management practices play grater role in present day crisis of water demand and Agronomy science answer to the questions 'how much to apply?' and 'when to apply?'.
- Intensive cropping is the need of the day and proper time and space intensification not only increase the production but also reduces the environmental hazards.
- New technology to overcome the effect of moisture stress under dry land condition is explored by Agronomy and future agriculture is depends on dry land agriculture.
- Packages of practices to explore full potential of new varieties of crops are the most important aspects in crop production which could be made possible only by Agronomy science.
- Keeping farm implements in good shape and utilizing efficient manner to nullify the present day labour crisis is further broadening the scope of agronomy.
- Maintaining the ecological balance through efficient management of crops, livestock and their feedings in a rational manner is possible only by knowing agronomic principles.
- Care and disposal of farm and animal products like milk and eggs and proper maintenance of accounts of all transactions concerning farm business is governing principles of agronomy.

Relation of agronomy to other sciences

Agronomy is a main branch of Agriculture. It is synthesis of several disciplines like soil science, Agricultural chemistry, crop physiology, plant ecology, biochemistry and economics.

- The Soil Science helps the agronomist to thoroughly understand the soil physical, chemical and biological properties to effect modification of the soil environment.
- The Agricultural Chemistry help the agronomist to understand the chemical composition and changes involved in the production, protection, and use of crops and livestock.
- The crop physiology helps to understand the basic life process of crops to understand functioning of each parts of plant to determine their input requirement like nutrients etc.
- The plant ecology helps us to understand the associated environment in which the crops grown like the influence of weather (Temperature, Rainfall etc).
- The biochemistry shows the way in which biochemical process takes place in crops which helps to understand critical requirements to favourably activate this process.
- The economics paves the way for profit and loss analysis in farming.

Role of Agronomist

Agronomist is a scientist who is dealing with the study of problems of crop production and adopting/recommending practices of better field crop production and soil management to get high yield and income.

- Agronomist aims at obtaining maximum production at minimum cost by exploiting the knowledge of the basic and applied sciences for higher crop production.
- In a broader sense, agronomist is concerned with production of food and fibre to meet the needs of growing population.
- He develops efficient and economic field preparation method for sowing crops in different season. (Flat bed, Ridges and furrows)
- He is also involved to selection of suitable crop and varieties to suit or to match varied seasons and soils. Eg. Red soil - groundnut, Black soil - cotton, Sandy soil – tuberous crops, Saline soil – Finger millet (*Ragi*). In *Kharif* if water is sufficient go for rice and water is not sufficient go for maize, sorghum.
- Evolves efficient method of cultivation (whether broadcasting, nursery and transplantation or dibbling, etc.) provides better crop establishment and maintain required population
- He has to identify various types of nutrients required by crops including time and method of application (e.g. for long duration rice (150-60-60 kg NPK), short duration: 120:50:50 kg NPK/ha Application P&K basal and N in three splits)
- Agronomist must select a better weed management practice. Either through mechanical or physical (by human work) or chemical (herbicides or weedicides, e.g. 2-4-D) or cultural (by having wide space it may increase weed growth by using inter space crops). Weeds are controlled by integrated weed management method also
- Selection of proper irrigation method, irrigation scheduling i.e. irrigation timing and quantity based on the crops to be irrigated, whether to irrigate continuously or stop in between and how much water to be supplied are computed by agronomy science so as to achieve maximum water use efficiency.
- Crop planning (i.e.) suitable crop sequence are developed by agronomist (i.e.) what type of crop, cropping pattern, cropping sequence, etc. (Rice - Rice - Pulse)
- Agronomists are also develops the method of harvesting, time for harvesting, etc. (Appropriate time of harvest essential to prevent yield loss)
- Agronomist is responsible for every decision made in the farm management. (What type of crop to be produced? How much area to be allotted for each crop? How and when to market? How and When to take other management activities?) All the decisions should be taken at appropriate time to efficiently use resources available)

Agro-climatic zones

An agro-climatic zone is a land unit uniform in respect of climate and length of growing period (LGP) which is climatically suitable for a certain range of crops and cultivars (FAO, 1983).

Classification by Planning Commission

Planning Commission of India (1989) made an attempt to delineate the country into different agro climatic regions based on homogeneity in rainfall, temperature, topography, cropping and farming systems and water resources. India is divided into 15 agro-climatic regions.

1. Western Himalayan zone

This zone consists of three distinct sub-zones of Jammu and Kashmir, Himachal Pradesh and Uttar Pradesh hills. The region consists of skeletal soils of cold region, podsolic mountain

meadow soils and hilly brown soils. Lands of the region have steep slopes in undulating terrain. Soils are generally silty loams and these are prone to erosion hazards.

2. Eastern Himalayan zone

Sikkim and Darjeeling hills, Arunachal Pradesh, Meghalaya, Nagaland, Manipur, Tripura, Mizoram, Assam and Jalpaiguri and Coochibihar districts of West Bengal fall under this region, with high rainfall and high forest cover. Shifting cultivation is practiced in nearly one-third of the cultivated area and this has caused denudation and degradation of soils with the resultant heavy runoff, massive soil erosion and floods in lower reaches and basins.

3. Lower Gangetic Plains zone

This zone consists of West Bengal-lower Gangetic plain region. The soils are mostly alluvial and are prone to floods.

4. Middle Gangetic Plains zone

This zone consists of 12 districts of eastern Uttar Pradesh and 27 districts of Bihar plains. This zone has a geographical area of 16 million hectares and rainfall is high. About 39% of gross cropped area is irrigated and the cropping intensity is 142%.

5. Upper Gangetic Plains zone

This zone consists of 32 districts of Uttar Pradesh. Irrigation is through canals and tube wells. A good potential for exploitation of ground water exists.

6. Trans-Gangetic Plains zone

This zone consists of Punjab, Haryana, Union territories of Delhi and Chandigarh and Sriganganagar district of Rajasthan. The major characteristics of this area are: highest net sown area, highest irrigated area, high cropping intensity and high groundwater utilization.

7. Eastern Plateau and Hills zone

This zone consists of eastern part of Madhya Pradesh, southern part of West Bengal and most of inland Orissa. The soils are shallow and medium in depth and the topography is undulating with a slope of 1-10%. Irrigation is through tanks and tube wells.

8. Central Plateau and Hills zone

This zone comprises of 46 district of Madhya Pradesh, part of Uttar Pradesh and Rajasthan. The topography is highly variable nearly $1/3^{rd}$ of the land is not available for cultivation. Irrigation and cropping intensity are low. 75% of the area is rainfed grown with low value cereal crops. There is an intensive need for alternate high value crops including horticultural crops.

9. Western Plateau and Hills zone

This zone comprises the major part of Maharastra, parts of Madhya Pradesh and one district of Rajasthan. The average rainfall of the zone is 904 mm. The net sown area is 65% and forests occupy 11%. The irrigated area is only 12.4% with canals being the main source.

10. Southern Plateau and Hills zone

This zone comprises 35 districts of Andhra Pradesh, Karnataka and Tamil Nadu which are typically semi-arid zones. Dryland farming is adopted in 81% of the area and the cropping intensity is 111 percent.

11. East Coast Plains and Hills zone

This zone comprises of east coast of Tamil Nadu, Andhra Pradesh and Orissa. Soils are mainly alluvial and coastal sands. Irrigation is through canals and tanks.

12. West Coast Plains and Ghats zone

This zone comprises west coast of Tamil Nadu, Kerala, Karnataka, Maharastra and Goa with a variety of crop patterns, rainfall and soil types.

13. Gujarat Plains and Hills zone

This zone consists of 19 districts of Gujarat. This zone is arid with low rainfall in most parts and only 32.5% of the area is irrigated largely through wells and tube wells.

14. Western Dry zone

This zone comprises nine districts of Rajasthan and is characterized by hot sandy desert, erratic rainfall, high evaporation, scanty vegetation. The ground water is deep and often brackish. Famine and drought are common features of the region.

15. Islands zone

This zone covers the island territories of Andaman and Nicobar and Lakshadeep which are typically equatorial with rainfall of 3000 mm spread over eight to nine months. It is largely a forest zone with undulated lands.

1	Western Himalayan Region	J&K, HP, UP, Utranchal
2	Eastern Himalayan Region	Assam Sikkim, West Bengal & North-Eastern states
3	Lower Gangetic Plains Region	West Bengal
4	Middle Gangetic Plains Region	UP, Bihar
5	Upper Gangetic Plains Region	UP
6	Trans-Gangetic Plains Region	Punjab, Haryana, Delhi & Rajasthan
7	Eastern Plateau and Hills Region	Maharastra, UP, Orissa & West Bengal
8	Central Plateau and Hills Region	MP, Rajasthan, UP
9	Western Plateau and Hills Region	Maharastra, MP & Rajasthan
10	Southern Plateau and Hills Region	AP, Karnataka, Tamil Nadu
11	East Coast Plains and Hills Region	Orissa, AP, TN,& Pondichery
12	West Coast Plains and Ghat Region	TN, Kerala, Goa, Karnataka, Maharastra

13	Gujarat Plains and Hills Region	Gujarat
14	Western Dry Region	Rajasthan
15	The Islands Region	Andman & Nicaobar, Lakshya Deep

Classification by ICAR

The State Agricultural Universities were advised to divide each state into sub-zones, under the National Agricultural Research Project (NARP) under ICAR. Based on the rainfall pattern, cropping pattern and administrative units, 127 agro-climatic zones are classified. The zones of each state are given below.

State	No. of zones	State	No. of zones
Andhra Pradesh	7	Madhya Pradesh	12
Assam	6	Rajasthan	9
Bihar	6	Maharashtra	9
Gujarat	8	North Eastern Hill region	6
Haryana	2	Orissa	9
Himachal Pradesh	4	Punjab	5
Jammu and Kashmir	4	Tamil Nadu	7
Karnataka	10	Uttar Pradesh	10
Kerala	8	West Bengal	6

The state of Tamil Nadu has been classified into seven distinct agro-climatic zones listed below.

1. North Eastern zone
2. North Western zone
3. Western zone
4. Cauvery Delta zone
5. Southern zone
6. High Rainfall zone
7. Hilly zone

1. North Eastern zone

This zone covers the districts of Thiruvallur, Vellore, Kanchipuram, Thiruvannamalai, Viluppuram, Cuddalore (excluding Chidambaram and Kattumannarkoil taluks), some parts of Perambalur including Ariyalur taluks and also Chennai. The mean annual rainfall of this region is 1054 mm received in 53 rainy days and is benefited by both the monsoons. The mean monthly maximum temperature ranges between 28.2 to 38.9 °C and the minimum ranges from 19.5 to 24.8°C.

2. North Western zone

This zone comprises of Dharmapuri and Krishnagiri district (excluding hilly areas), Salem, Namakkal district (excluding Tiruchengode taluk) and Perambalur taluk of Perambulur district. The climate prevailing in this region is dry and sub humid. This region has been identified as moderately drought prone area. The elevation varies from 330 to 1070 m above mean sea level. The mean annual rainfall of this region is appreciably lower than in North Eastern zone and is 825 mm received in 47 rainy days. The region is benefited by both south-west and north-east monsoon rains but unlike the NEZ, the former contributed more to the total rainfall. The mean monthly maximum temperature ranges between 30 to 37°C with minimum temperature ranging between 19 to 25.5°C. The annual PET of this region is 1727 mm compared to the annual precipitation of 825 mm.

3. Western zone

This zone comprises of Erode, Coimbatore, Dindigal, Theni districts, Tiruchengode taluk of Namakkal district, Karur taluk of Karur district and some western part of Madurai district. The mean annual rainfall is 718 mm in 45 rainy days. The monthly mean maximum temperature is 35°C in April and 30°C in January and November. The monthly mean minimum temperature is 19°C in January and 24°C in May.

4. Cauvery Delta zone

This zone comprises the Cauvery Delta area in Thanjavur, Thiruvarur, Nagapattinam districts and Musiri, Tiruchirapalli, Lalgudi, Thuraiyur and Kulithalai taluks of Tiruchirapalli district, Aranthangi taluk of Pudukottai district and Chidambaram and Kattumannarkoil taluks of Cuddalore district. The mean annual rainfall of the zone is 1078 mm out of which 40mm is received during winter, 69.2mm during summer, 295.4mm during South West Monsoon and 673.8mm during North East Monsoon.

5. Southern zone

This is the biggest among the seven zones of Tamil Nadu. It is typical zone surrounded by coastal areas on the East and mountains in the West. This zone comprises Sivagangai, Ramanathapuram, Virudunagar, Tuticorin and Tirunelveli districts and Natham and Dindigul taluks of Dindigul district, Melur, Tirumangalam, Madurai South and Madurai North taluks of Madurai district and Pudukkottai district excluding Aranthangi taluk. This zone lies on the Southern part of the State under rain shadow area. Because of this, the area is prone to drought very often. The climate is semi-arid tropics. The elevation varies from mean sea level to 300 m. The mean annual rainfall is 776 mm received in 43 rainy days. The monthly mean maximum temperature in this region ranges from 28.5°C in December to 38.5°C in June. The monthly mean minimum temperature varies from 21.0°C in January to 27.5°C in June.

6. High rainfall zone

This zone consists of Kanayakumari district. This district situated in the southern most part of the Peninsular India, with its high rainfall having a climate which is entirely different from the rest of the state. The climate is monsoon tropics and there is seasonal in shores flow of moist air. The elevation ranges from sea level to about 600 m. The mean annual rainfall of the district is 1469 mm received in 64 rainy days. There is not much fluctuation in the mean monthly air temperature. The monthly mean maximum temperature varies from 28.0°C in December to 33.5°C in May. The monthly mean minimum temperature varies from 22°C in December to 26.5°C in May.

7. High altitude and Hilly zone

This zone comprises the hilly regions, namely the Nilgiris, Shevroys, Elagiri-Javvadhu, Kollimalai, Patchaimalai, Anamalais, Palanis and Podhigaimalais. The rainfall varies from 850 mm in Kalrayan hills to about 4500 mm in Anamalai hills.

Agro-ecological zones of India

An ecological region is characterized by distinct ecological responses to macroclimate as expressed in vegetation and reflected in soils, fauna and aquatic systems. Therefore, an agro-ecological region is the land unit on the earth's surface carved out of agro-climatic region when superimposed on different landform and soil conditions that act as modifiers of climate and length of growing period (LGP).

National Bureau of Soil Survey and Land Use Planning (NBSS & LUP) of the ICAR has delineated 20 agro-ecological regions (AERs) in the country using the FAO 1978 concept of superimposition of length of growing periods and bio-climate maps on soil physiographic map.

Arid ecosystem

1. Western Himalayas, cold eco-region, shallow soils, LGP <90 days.
2. Western plain Kachohh and parts of Kathiawar Peninsula, hot arid eco-region, desert and saline soils. LPG <90 days.
3. Deccan plateau, hot arid ecoregion, red and black soils. LGP <90 days.

Semiarid ecosystem

4. Northern plain and central high lands, hot semiarid eco-region, alluvial soils. LGP 90-150 days.
5. Central high lands, Gujarat plains, Kathiawar peninsula, hot semiarid eco-region, medium and deep black soils. LGP 90-150 days.
6. Deccan plateau, hot semiarid ecoregion. LGP 90-150 days.
7. Telangana, Eastern ghats, hot semiarid eco-region. LGP 90- 150 days.
8. Eastern ghats, Tamil Nadu uplands and Karanataka plateau, hot semiarid eco-region. LGP 90-150 days.

Subhumid Ecosystem

9. Northern plain, hot sub-humid (dry) eco-region, red and black soils. LGP 150-180 days.
10. Central highlands, hot sub-humid eco-region, black and red soils. LGP 150-180 (210) days.
11. Eastern plateau, hot sub-humid eco-region, red and yellow soils, (210) days. LGP 150-180 days.
12. Eastern plateau (Chotanagpur) and Eastern ghats hot sub-humid eco-region, red and lateritic soils. LGP 150-180 (210) days.
13. Eastern plain, hot sub-humid (moist) eco-region, alluvial soils. LGP 180-210 days.
14. Western Himalayas, warm sub-humid to humid eco-region with brown forest soils. LGP 180-210+ days.

Humid-Perhumid ecosystem

15. Bengal and Assam plain hot sub-humid (moist) to humid eco-region, alluvial soils. LGP 210+ days.
16. Eastern Himalayas, warm per-humid eco-region, brown and red hill soils. LGP 210 + days.
17. North eastern hills, warm per-humid eco-region, red and lateritic soils. LGP 210+ days.

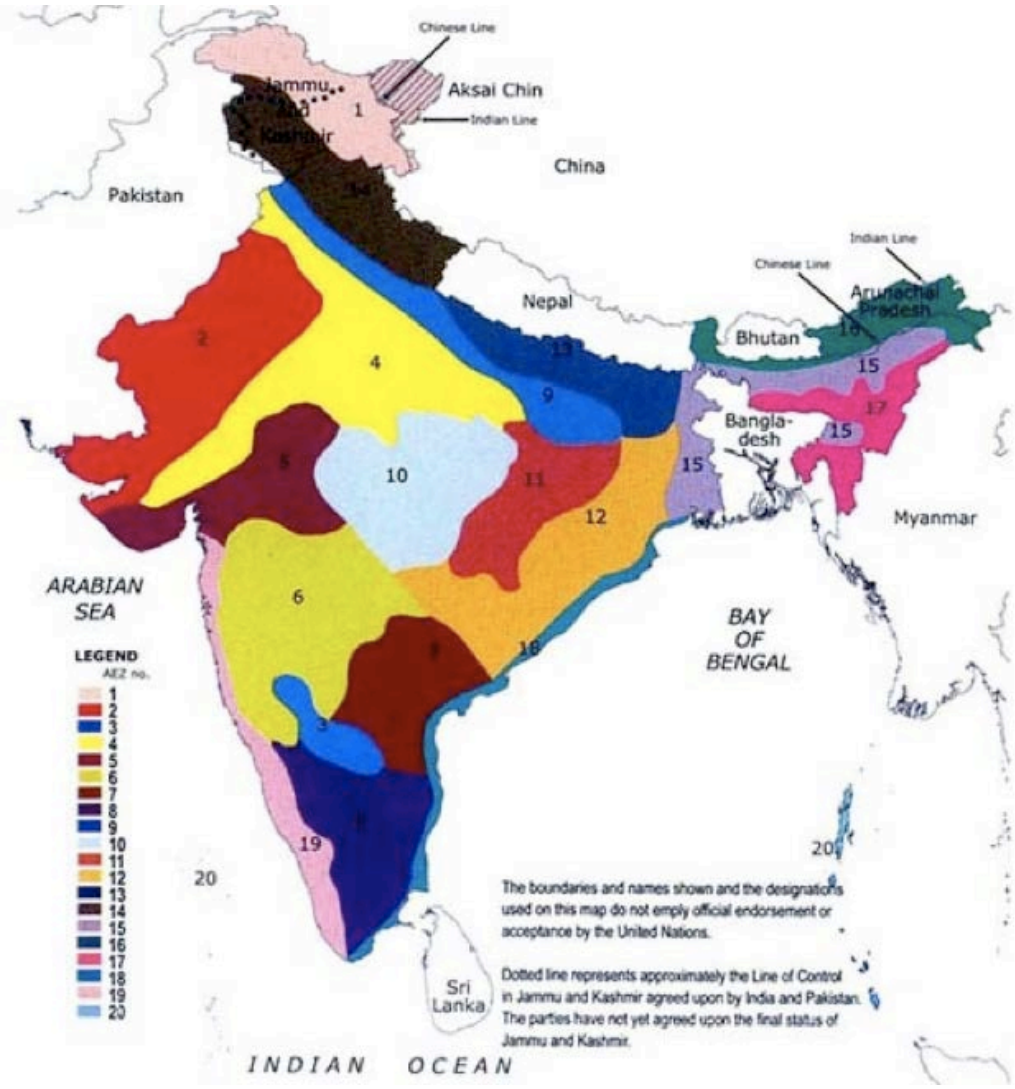
Coastal Ecosystem

18. Eastern coastal plain, hot sub-humid to semiarid eco-region, coastal alluvium. LGP 90-210 +days.
19. Western Ghats and coastal plain, hot humid-per-humid eco-region, red, lateritic and alluvium derived soils. LGP 210+ days.

Island Ecosystem

20. Andaman Nicobar and Lakshadeep, hot humid to per-humid eco-region, real loamy and sandy soils. LGP 210+ days.

The major advantage of LGP based criteria is that the LGP is the direct indicative of moisture availability of a given landform rather than the total rainfall. For example, both Ratnagiri in western Maharashtra and Nagpur in eastern Maharashtra have LGP 180-210 + days but the total annual rainfall of Ratnagiri is more than 2000 mm where as that of Nagpur is only 1100 mm. Therefore, agro-ecosystems approach allows crop planning based on length of growing period rather than the quantity of rainfall.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The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.
Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The parties have not yet agreed upon the final status of Jammu and Kashmir.