कृषि एवं किसान
कल्याण मंत्रालय
MINISTRY OF
AGRICULTURE AND
FARMERS WELFARE

सत्यमेव जयते

भाकृअनुप
ICAR

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CAFRI

Promising Agroforestry Models for Andhra Pradesh

ICAR-Central Agroforestry Research Institute

Jhansi-284003, Uttar Pradesh, India

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Disclaimer

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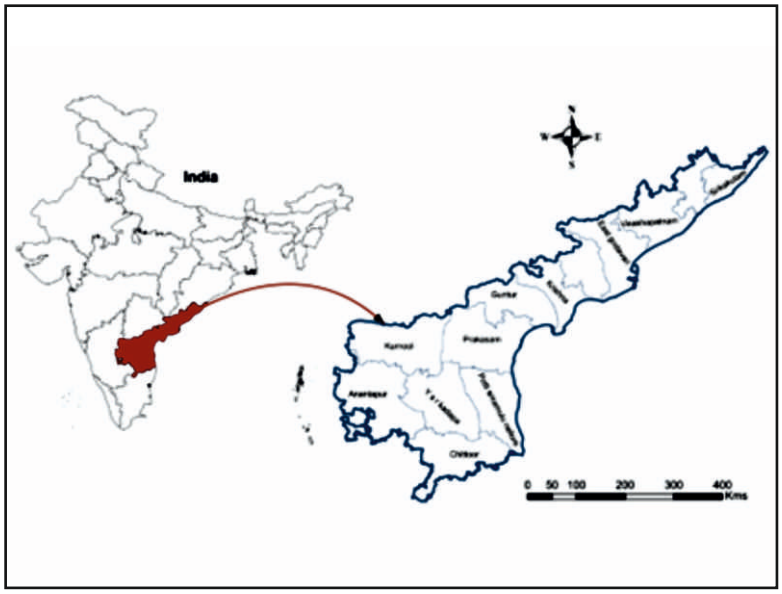
Promising Agroforestry Models for Andhra Pradesh



Andhra Pradesh, also known as "Telugu Nadu" or "Land of Telugu," was established on October 1, 1953 when Telugu-speaking regions were separated from the Madras Presidency to form Andhra State. This state was later merged with the Telangana region on November 1, 1956, under the States Reorganization Act resulting in the formation of Andhra Pradesh as a full-fledged state. Located on India's southeastern coast Andhra Pradesh is the eighth largest state by area, covering 160,205 km² . The proposed new capital city is Amaravati, situated in Guntur District. The state boasts a coastline of 972 km making it the second longest in India after Gujarat. It shares borders with Telangana to the northwest, Chhattisgarh to the north, Odisha to the northeast, Karnataka to the west, Tamil Nadu to the south and the Bay of Bengal to the east. Additionally, a small enclave of Yanam lies within its territory (APIIC, 2024).

Physiography

Andhra Pradesh state can be divided into three regions

- The Coastal plains
- The Eastern Ghats
- The Western pene plains

1. Coastal Plains

The Coastal Plains of Andhra Pradesh extend from the northern Srikakulam district to the southern Nellore district. The northern section is relatively narrow, with an average width of 30 to 40 km. In contrast, the central portion is broader, averaging 70 to 75 km and reaching up to 100 km in some areas. This region includes the shallow freshwater Kolleru Lake, a natural depression situated between the deltas of the Godavari and Krishna rivers. The southern section of the coastal plain measures between 50 and 60 km in width. Notable geographic features within this area include the Simhachalam Cliff (244 m), Dolphin's Nose (375 m), Kondapalli Hill (573 m), Kolleru Lake (259 sq km), Pulicat Lake and Sriharikota Island.

2. Eastern Ghats

The Eastern Ghats comprise a series of hills that do not form a continuous range like the Western Ghats, instead presenting a fragmented topography between the coastal plains and the Deccan Plateau. This range includes outcrops from the lower Vindhya and Cuddapah systems. The hills are extensively dissected by numerous valleys, with widths ranging from 60 to 70 km and elevations often exceeding 1200 meters above mean sea level. The northern part of the range features the Papikonda Hills, which connect with the Simhachalam range. The Yarada Hills extend toward the coast near Visakhapatnam. Further southwest, the Eastern Ghats transition into the Cuddapah Hills, known by various names including Palakondas, Velikondas, Erramalais, Nallamalais, Lankamalais, and Seshachalam, with elevations ranging from 600 to 1350 meters.

3. The Western Peneplains

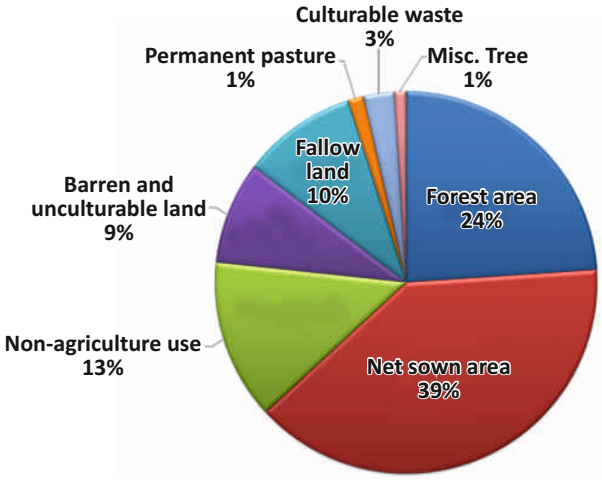
The Western Peneplains, characterized by scattered hillocks, primarily cover Kurnool district (excluding the Nallamalai region), Anantapur district and the entirety of Telangana. This interior plateau consists of a long belt of ancient peneplains, situated at altitudes between 150 and 600 meters, predominantly formed on Archaean gneisses and granite substrates. The southern part of this region experiences low rainfall and is relatively arid. In the northern region, remnants of Gondwana deposits containing coal are preserved along the lower Godavari trough, with much of the area lying below 150 meters and largely covered by deciduous forests (ENVIS Andhra Pradesh).

Climate

The climate of Andhra Pradesh varies significantly across its geographical regions. Summer spans from March to June, with coastal areas experiencing higher temperatures, typically ranging from 20°C to 41°C. The state is characterized by high humidity due to its proximity to the Bay of Bengal. Tropical rains occur from July to September with about one-third of the total rainfall coming from the southwest monsoon. In October and November low-pressure systems and tropical cyclones in the Bay of Bengal bring additional rainfall to the southern and coastal regions aided by the northeast monsoon. Winter lasts from November to February with mild temperatures generally between 12°C and 30°C. The coastal location prevents extreme winter temperatures though Lambasingi in Visakhapatnam district known as the "Kashmir of Andhra Pradesh," experiences cooler conditions ranging from 0°C to 10°C. Summers are notably hot and humid with maximum temperatures often exceeding 35°C and can reach over 40°C in central regions. Winters are cooler with maximum temperatures between 30°C and 35°C except in the northeastern areas where lows can drop below 15°C. Annual precipitation largely depends on the southwest monsoon decreasing towards the southwestern plateau with coastal regions receiving 1,000 to 1,200 mm of rainfall, while the western plateau may receive only about half that amount (SAPCCHH, 2022).

Land use pattern

Andhra Pradesh covers a total geographical area of 36.88 lakh hectares, with forest cover accounting for only 22.63% of the land. In 2022, the net sown area reached 60.38 lakh hectares, representing 37.05% of the total area, reflecting a slight decrease of 0.06% compared with the previous year.



***Source*:** Socio Economic Survey (2024)

Forests and its resources

Andhra Pradesh encompasses seven of India's sixteen major forest types, which include Tropical Semi-Evergreen, Tropical Moist Deciduous, Tropical Dry Deciduous, Tropical Dry Evergreen, Tropical Thorn, Scrub, and Savanna and Littoral Swamp forests (ENVIS, 2007). Andhra Pradesh has a recorded forest area of 29,784.34 km² which constitutes 18.28% of its total geographical area. The forest cover includes very dense forests (1,994.28 km²), moderately dense forests (13,928.75 km²) and open forests (13,861.27 km²). East Godavari district known for its tribal population has the highest forest cover accounting for

39.99% of its geographical area. Within the Recorded Forest Area (RFA), Andhra Pradesh encompasses 24,239 km², with an additional 5,545 km² located outside the RFA. The state's tree cover has increased from 3,914 km² in 2019 to 4,679 km² in the 2021 assessment. Trees outside forests (TOF) cover 10,224 km² and include both forest cover outside the RFA and tree coverage. The leading tree species in rural areas are *Mangifera indica* (28.83%), *Borassus flabelliformis* (9.61%), *Azadirachta indica* (9.25%), *Cocos nucifera* (8.47%) and *Anacardium occidentale* (6.03%). In urban regions the top species include *Cocos nucifera* (15.87%), *Azadirachta indica* (12.49%), *Pongamia pinnata* (7.36%), *Mangifera indica* (7.13%) and *Tectona grandis* (6.54%). The total carbon stock in Andhra Pradesh forests including TOF patches larger than one hectare, is estimated at 230.22 million tonnes, representing 3.20% of India's total carbon stock. Additionally, major non-timber forest products (NTFP) in the state include species like *Solanum nigrum*, *Hemidesmus indicus* and *Cardiospermum helicabum* (ISFR, 2021).

Forest types

S.No.	Type of Forest	Area (in sq. km)	% of the total mapped area
1.	Southern moist mixed deciduous forest	1752.05	4.64
2.	Littoral forest	51.93	0.14
3.	Mangrove forest	404.14	1.07
4.	Dry teak forest	551.72	1.46
5.	Dry red sanders-bearing forest	1085.99	2.88
6.	Southern dry mixed deciduous forest	14970.34	39.66
7.	Dry peninsular sal forest	0.62	0.00
8.	Northern dry mixed deciduous forest	0.68	0.00
9.	Dry deciduous scrub	12892.22	34.16
10.	Dry savannah forest	35.98	0.10
11.	*Hardwickia* forest	8.73	0.02
12.	Dry bamboo brakes	297.85	0.79
13.	Secondary dry deciduous forest	724.19	1.92
14.	Southern thorn forest	1659.27	4.40
15.	Carnatic umbrella thorn forest	21.75	0.06
16.	Southern thorn forest	12.80	0.03
17.	Southern *Euphorbia* scrub	0.26	0.00
18.	Tropical dry evergreen forest	434.95	1.15
19.	Tropical dry evergreen scrub	17.60	0.05
20.	TOF/Plantation	2469.17	6.54
21.	Dry grassland	352.08	0.93
	Grand Total	37744.32	100

***Source*:** ISFR (2021)

Forest types have been assigned to the natural forest formations under forests cover and scrub categories shown in forest cover mapping (ISFR, 2019)Grassland forest type outside forest cover has also been mapped. The total mapped area therefore, is sum of forest cover, scrub and grassland forest types (found in non-forest).

Soil

Andhra Pradesh is primarily an agriculture-focused state, featuring a wide range of soils that vary from the less fertile coastal sands to the highly fertile deltaic alluvium of the Godavari, Krishna, and Pennar rivers, along with red and black soils derived from different parent materials. Over 60% of the working population is engaged in agriculture, which is the cornerstone of their livelihoods. The common types of soil found in the state include:

- Red soil
- Black soil
- Deltaic alluvial soils
- Coastal alluvial soils
- Laterite soil
- Skeletal soils.

Red Soils

Red soils, covering about 66% of Andhra Pradesh's land area, originate from granites, gneisses, and schists, influenced by variations in mineral composition and topography. They include six sub-groups: red sandy soils (8%), red earths with loamy sub-soils (30%), red earths with clay sub-soils (3%), red loamy soils (9%), deep red loamy soils (3%), and red soils with a clay base (12%). These soils typically lack organic matter, are rich in phosphoric content and have poor moisture retention. They primarily extend across the Telangana and Rayalaseema regions, as well as upland areas in several other districts.

Black Soils

Black soils, covering nearly 25% of the state's area, also derive from granites and gneisses and are known as Regurs or Vertisols. These soils are moderately to very deep, can be calcareous or non-calcareous, and are characterized by fine texture and strong alkalinity, though they are low in nitrogen and phosphorus. Rich in calcium and potash, significant belts of black soil are found along the Godavari River and in districts like Adilabad, Karimnagar and Warangal. Deep and medium black soils, often referred to as black cotton soils, are prevalent in western and northwestern regions, especially near major rivers. Light black soils appear in the northwestern part, while mixed black and red soils exist between the Krishna and Pennar rivers.

Deltaic Alluvial Soils

The deltaic alluvial soils are the most fertile in the state, enriched by silt from river flooding. They are of recent origin and are nutrient-rich, found primarily in the Krishna and Godavari deltas, as well as along the coast and river valleys like Vansadhara and Nagavali.

Coastal Alluvial Soils

Older and less fertile than deltaic soils, coastal alluvial soils form a narrow belt along the coast, particularly in Visakhapatnam. They consist mainly of sand or sandy loam, lacking in plant nutrients and organic matter. *Casuarina* and cashew plantations thrive here, with mangroves found in Krishna and East Godavari districts.

Lateritic Soils

Comprising about 1% of the state, lateritic soils vary from reddish to brown or black and are characterized by low organic matter and nutrients. They are porous, medium to fine-textured, and acidic, primarily composed of hydrated aluminum and iron oxides. Found in Srikakulam, Visakhapatnam and other districts, these soils are suitable for horticulture and oilseed production.

Coastal Sandy Soils

Coastal sandy soils are formed from sandstones and quartzites, characterized by deep, coarse textures and neutrality. They are located in parts of Krishna, Guntur and Prakasam districts.

Skeletal Soils

Skeletal soils are found on the Nallamala slopes in areas like Cuddapah and Prakasam, typically infertile and located on highly eroded hill slopes or near foothills (ENVIS Andhra Pradesh).

Water Resources of Andhra Pradesh

The source of water in the state is groundwater. Current resource estimates indicate that the net annual extractable groundwater resource is approximately 22,944 million cubic meters (MCM) of this 13,135 MCM is available in command areas while 9,809 MCM is found in non-command areas. Additionally, there are 2,621 MCM located in regions with poor groundwater quality, which cannot be utilized immediately due to its unsuitability for use without treatment or improvement (CGWB, 2021).

S.No.	Description	Command	Non-command	Total	Poor Ground Water Quality	Grand Total
1	Area considered for recharge in Sq.Kms	44500	84749	129249	8144	137393
2	Net annual extractable groundwater resource in MCM	13135	9809	22944	2621	25564
3a	Annual gross ground water extraction for irrigation use in MCM	2522	4073	6595	41	6636
3b	Annual gross annual groundwater extraction for Domestic needs in MCM	303	577	880	13	893
3c	Annual gross annual groundwater extraction for Industrial needs in MCM	85	69	155	32	187
3d	Groundwater extraction for all uses in MCM	2911	4719	7630	86	7716
4	Net annual groundwater availability for future use in MCM	10283	5629	15912	2555	18466
5	Stage of Groundwater Extraction (%)	22	48	33	-	-
6	Projected annual allocation of ground water for domestic water supply as on 2025 in MCM	434	868	1302	0	1302

Source: CGWB (2021)

Agriculture

Andhra Pradesh, primarily an agro-based economy sees agriculture and allied sectors contributing over 29% to its Gross State Domestic Product (GSDP) compared to 17% of the national GDP. Ten major crops dominate 80% of the gross cropped area out of a total of 165 crops identified. These key crops are recognized as growth drivers to accelerate the agricultural economy through targeted strategies. Agriculture serves as a backbone for achieving inclusive double-digit growth, positively impacting other sectors like manufacturing and trade. Acknowledging the sector's significance, the Andhra Pradesh government is implementing best practices to enhance productivity and ensure the well-being of farmers, thereby supporting overall economic development (Government of Andhra Pradesh, 2024).

Major crops in Andhra Pradesh (in "000 tonnes")

Crop	Production
Rice	7942
Jowar	284
Maize	2755
Bajra	51
Coarse Cereals	3131
Ragi	32
Small Millets	9
Arhar (Tur)	78
Gram	457
Horsegram	1400

Greengram	73
Blackgram	431
Castor Seed	14
Groundnut	601
Rapeseed and Mustard	1
Safflower	3
Sesamum	8
Soyabean	28
Sunflower	18
Cotton	1541
Jute and Mesta	11
Sugarcane	2956
Coffee	12.265
Total	21836.265

Source: Agricultural Statistics at a Glance, (2023)

Schemes of Andhra Pradesh

The Government of Andhra Pradesh has implemented various schemes, including the National Food Security Mission (NFSM), *Rashtriya Krishi Vikas Yojana* (RKVY), National Horticulture Mission, and *Mahila Dairy Sahakara Sanghalu* (MDSS), along with several agriculture-related initiatives. These programs aim to enhance agricultural productivity and support farmers across the state. According to the 20th livestock census, livestock population Andhra Pradesh is 141.9 million (Ministry of Agriculture, Depertment of Animal Husbandry, Dairying and Fisheries, 2019).

S.No.	Scheme	Objective
1.	Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS)	The scheme aims to provide livelihood security to households in rural areas by guaranteeing at least 100 days of wage employment per financial year to every household willing to undertake unskilled manual work. This program is designed to enhance employment opportunities and ensure income stability for rural households, thereby contributing to their overall well-being and reducing poverty.
2.	National Food Security Mission (NFSM)	The National Food Security Mission (NFSM) is a centrally sponsored program launched in October 2007, aimed at increasing the production of various crops, including rice, wheat, pulses, and oilseeds, through area expansion and productivity improvements in specific districts. It also focuses on restoring soil fertility at the farm level and enhancing the economic viability of farming to rebuild farmers' confidence. Additionally, the mission aims to boost the production of vegetable oils from oilseeds to decrease dependence on imported edible oils.

3.	Sub Mission on Agricultural Extension (Agriculture Technology Management Agency- ATMA)	Under the "Support to State Extension Programmes for Extension Reforms" (ATMA) scheme, all 13 districts of Andhra Pradesh are included, with funding shared at a ratio of 60:40 between the central and state governments. This initiative is part of the National Mission on Agricultural Extension & Technology (NMAET) and aims to enhance agricultural extension services across the state.
4.	*Rastriya Krishi Vikas Yojna* (RKVY-RAFTAAR)	The *Rashtriya Krishi Vikas Yojana* (RKVY) is a key initiative of the Government of India, with funding shared between the Central and State governments at a ratio of 60:40. As of 2017-18 the scheme has been rebranded as *Rashtriya Krishi Vikas Yojana* - Remunerative Approaches for Agriculture and Allied Sector Rejuvenation (RKVY-RAFTAAR). Its primary aim is to transform farming into a profitable economic venture by enhancing farmers' efforts, mitigating risks, and encouraging agribusiness entrepreneurship. The programs will be executed by the Agriculture and Allied sectors.
5.	*Paramparagat Krishi Vikas Yojna* (PKVY)	*Paramparagat Krishi Vikas Yojna* (PKVY) is a scheme under National Mission for Sustainable Agriculture (NMSA). It aims at development of sustainable models of organic farming through integrating traditional and modern science to ensure long term soil fertility, resource conservation and address climate change.
6.	National Horticulture Mission (NHM)	The National Horticulture Mission (NHM) is a centrally sponsored scheme launched during the 10th Five Year Plan (2005-06 and 2006-07), providing full assistance to State missions. Its main objective is to achieve comprehensive development of horticulture through an "end to end" approach, covering everything from planting material production to marketing and export after value addition. NHM aims to double the output and productivity of key horticultural crops and improve the quality of produce.
7.	National Mission for Sustainable Agriculture (NMSA), Sub Mission on Agroforestry (SMAF)	The initiative is designed to promote and enhance tree plantation systematically, ensuring access to high-quality plant materials like seeds, seedlings, clones, and improved varieties. It aims to encourage diverse agroforestry practices suited to different agro-ecological regions and land use patterns, while also providing extension services and capacity-building support to the agroforestry sector. The funding structure consists of 60% central government contribution and 40% state government contribution.

8.	*Mahila dairy Sahakara Sanghalu* (MDSS)	The State Government is focused on revitalizing dairy cooperatives to provide better prices for dairy farmers. To achieve this, it has partnered with Amul for marketing support and plans to establish *Mahila Dairy Sahakara Sanghalu* (MDSS) in key milk-producing villages. Andhra Pradesh has a milch animal population of 6 million, predominantly buffaloes (58%), and is known for its Ongole and Punganur cattle breeds. Over 2.7 million rural women participate in dairy farming, though most milk procurement remains in the unorganized sector.
9.	*Pradhana Mantri Krishi Sinchayee Yojana*	The Andhra Pradesh Micro Irrigation Project (APMIP), launched under PMKSY, is a pioneering project in Andhra Pradesh aimed at enhancing crop productivity through micro irrigation systems. Implemented across 26 districts since 2003-04, it has covered 13.41 lakh hectares, benefiting 11.91 lakh farmers. The state government provides subsidies to encourage drip irrigation adoption, particularly in the Rayalaseema region and other water-scarce areas, promoting efficient water usage and higher yields.
10.	Mission for Integrated Development of Horticulture (MIDH)	The Mission for Integrated Development of Horticulture (MIDH) is a centrally assisted state development scheme implemented in Andhra Pradesh to promote holistic growth of the horticulture sector. It focuses on comprehensive development of all sub-sectors to provide additional income to growers. The scheme covers 9 districts and 3 ITDA areas, with a financial outlay of Rs. 18,000 lakh for 2023-24, targeting 16,460 ha of plantation and other components.
11.	National Mission on Edible oils (NMEO-OP) Oil Palm	Andhra Pradesh leads India in oil palm cultivation, covering 1.92 lakh hectares with 1.41 lakh farmers across 17 districts. The average productivity is 19.81 tons of Fresh Fruit Bunches (FFB) per hectare, producing 18.49 lakh MT of FFB and 3.20 lakh MT of Crude Palm Oil (CPO) in 2021-22. Eluru district has the highest area under oil palm at 61,787 hectares. Thirteen processing units have been established, and during 2022-23, 8,973 hectares were planted against a target of 20,000 hectares, with expenditures reaching Rs. 4,335.56 lakh out of a planned Rs. 10,414.91 lakh.
12.	*Nagaravanams*	The State Government initiated *Nagaravanams* (City Forests) schemes aims to create a healthy urban environment while promoting the development of smart, clean, and green cities. To date, 23 *Nagaravanams* have been established and opened to the public. Additionally, 7 Temple Eco-parks are being developed to raise awareness about environmental issues and enhance the aesthetic appeal for pilgrims. Various theme parks are also planned to highlight the historical significance of these temples. For the fiscal year 2022-23, Rs. 1,494 lakh has been allocated for the establishment and maintenance of both *Nagaravanams* and Temple Eco-parks across the state.

13.	*Vana Vihari* (Eco-Tourism)	The state has initiated a scheme to establish new community-based eco-tourism centers while enhancing the existing ones within forest areas. This initiative aims to develop facilities such as cottages, dormitories, nature camps, nature trails, boating activities, watch towers, and interpretation centers throughout the state.
14.	Social Forestry	The State Government has initiated a significant public movement that actively engages citizens and farmers to enhance tree cover outside of reserve forests, aiming to improve the environment and create job opportunities for thousands of unemployed youth. Under the Social Forestry program, efforts include distributing seedlings to the public, establishing community land plantations, avenue and shelterbelt plantations, as well as developing institutional plantations.
15.	09- Mixed plantation Scheme	The 09-Mixed Plantation Scheme aims to enhance green cover in 2022-23 by planting 115 km of avenue and distributing 19.85 lakh seedlings. Additionally, Vanamahotsavam will be celebrated at the district and mandal levels, while maintaining previously established avenue plantations, with a financial allocation of Rs. 550 lakh.

Biodiversity

India is a highly diverse nation home to approximately 7–8% of all documented plant and animal species despite occupying only 2.4% of the world's land area. As one of the 17 megabiodiversity countries India is recognized for its wealth of traditional knowledge related to biodiversity which is primarily preserved by local communities. Andhra Pradesh in particular, showcases rich biodiversity through its varied ecosystems and habitats. The state features 1 Tiger Reserve, 1 Elephant Reserve (Koundinya Sanctuary and Rayala Elephant Reserve), 1 Biosphere Reserve (Seshachalam), 3 National Parks and 13 Wildlife Sanctuaries (Forest Department of Andhra Pradesh).

Group of organisms	Number of species in Andhra Pradesh
Mammals	108
Birds	489
Reptiles	103
Amphibians	23
Fresh water fishes	180
Marine and Estuarine fishes	More than 600
Molluscs	480
Arthropods	1337
Annelids	163
Angiosperms	3000
Gymnosperms	3
Pteridophytes	72
Bryophytes	100

Trees	550
Shrubs	285
Herbs	1765
Climbers	300

***Source*:** Andhra Pradesh Biodiversity Board (2024)

Agro-climatic Zones

Andhra Pradesh is categorized into six agro-climatic zones based on factors such as rainfall patterns, soil types, elevation, and predominant crops. The zones include the North Coastal Andhra, South Coastal Andhra, Godavari, Krishna, Scarce Rainfall and High Altitude zones. This classification helps in understanding the agricultural potential and ecological characteristics of the state facilitating better planning and resource management.

Agro-climatic Zones of Andhra Pradesh

S.No.	Name of the Zone	District name
1.	North Coastal Andhra zone	Srikakulam, Vizianagaram & Visakhapatnam
2.	South Coastal Andhra zone	Nellore, Chittoor & Kadapa
3.	Godavari zone	East & West Godavari
4.	Krishna zone	Guntur, Krishna & Prakasam
5.	Scarce Rainfall zone	Ananatapur & Kurnoo
6.	High Altitude zone	Srikakulam, Vizianagaram, Visakhapatnam & East Godavari

Demography

According to the 2011 Indian Census, Andhra Pradesh has a population of approximately 49.6 million people, with 24.8 million men and 24.7 million women representing 4.09% of India's total population of 1.21 billion. The state has a population density of 304 individuals per km², which is lower than the national average of 382 per km². The literacy rate in Andhra Pradesh stands at 67.41%, while the sex ratio is 997 females for every 1,000 males, slightly increase in comparison of the national average of 943 (Government of India, 2011).

Administrative profile

The reorganized state of Andhra Pradesh was established on June 2, 2014, following the Andhra Pradesh Reorganization Act, 2014, also known as the Telangana Act. This bifurcation resulted in the separation of Telangana from the unified state of Andhra Pradesh creating two distinct states within India. Andhra Pradesh is divided into 26 districts and has a rich history of collaboration with key planning groups at both district and municipal levels. The state's administrative structure includes 77 revenue divisions, 431 blocks, 685 mandals, 31 cities, 104 towns, 27,800 villages and 21,843 gram panchayats. The districts are: Alluri Sitharama Raju, Anakapalli, Ananthapuramu, Annamayya, Bapatla, Chittoor, Dr. B.R. Ambedkar Konaseema, East Godavari, Eluru, Guntur, Kakinada, Krishna, Kurnool, Nandyal, NTR, Palnadu, Parvathipuram Manyam, Prakasam, Sri Potti Sriramulu Nellore, Sri Sathya Sai, Srikakulam, Tirupati, Visakhapatnam, Vizianagaram, West Godavari, and Y.S.R.

State symbols

Andhra Pradesh has several official state symbols that represent its natural heritage. The Indian antelope (*Antilope cervicapra*), commonly known as Krishna Jinka in Telugu, is the state animal. The Rose Ringed Parakeet (*Psittacula krameri*), referred to locally as Rama Chiluka, serves as the state bird. The state flower is the Jasmine (*Jasminum officinale* L.), while the Neem tree (*Azadirachta indica*) is designated as the state tree. Additionally, the Mango (*Mangifera indica*), known as Aam in Hindi and Mamidi in Telugu, is recognized as the state fruit. The Striped Snakehead (*Channa striata*), locally called Korramatta or Korrameenu, is the state fish of Andhra Pradesh. The primary languages spoken in Andhra Pradesh include Telugu, Urdu, Hindi, Banjara, and English, with additional languages such as Tamil, Kannada,

Marathi, and Oriya also present. Telugu serves as the official and most widely spoken language in the state, reflecting its cultural significance.

Promising Agroforestry Models for Andhra Pradesh

S.No.	Agroforestry models	Tree component	Crop component	Economic returns/ Benefit Cost Ratio (BCR)
1.	Horti-pastoral system	Custard apple and Amla	*Stylosanthes hamata* and *Cenchrus ciliaris*	The highest fodder yield was observed in custard apple intercropped with *Stylosanthes*, yielding 54.96 t/ha. This was followed by custard apple with *Cenchrus* at 48.94 t/ha, and Amla with Cenchrus at 36.33 t/ha.
2.	Silvi-pastoral system	*Acacia nilotica*	*Stylosanthes hamata* and *Cenchrus ciliaris*	The biomass yield of *Acacia nilotica* was also assessed and it was found to be superior when grown with *Stylo* (84.4q/ha) as compared to *Cenchrus* (75.6 q/ha)
3.	Agri-horti system	Custard apple	Castor *var* DCS-9	The intercrop yield and fruit yields of custard apple, along with the B:C ratio ranged from 1:1.12 to 1:1.49.
4.	Agri-silvi-horti system	Tamarind (PKM-1), Custard apple and Curry leaf	Redgram, Jowar, Cowpea and Cluster bean	The highest B:C ratio attain in the Curryleaf with Redgram (3.04) followed by Custard apple with Redgram (2.09) and Curryleaf with Jowar (1.95)
5.	Agri-silviculture system	*Emblica officinalis* and *Terminalia chebula*	Coleus, Aswagandha and Andrographis	The intercrops recorded highest B:C ratio of 1:4.5 with Andrographis was followed by 1:2.4 sole Coleus and 1:1.9 sole Aswagandha
6.	Agri-silviculture system	*Pongamia pinnata*	Pearl millet	The combination of 75% RD N and 25% N from poultry manure achieved the highest yields, with grain at 12.67 q/ha and stover at 30.33 q/ha. This was followed by the 75% RD N and 25% N from vermicompost, which produced grain yields of 20.13 q/ha and stover yields of 28.66 q/ha.
7.	Agri-silviculture system	*Melia azedarach*	Finger millet	The sole crop, grown without trees, reached the highest grain yield of 2,681.3 kg/ha and a straw yield of 5,063.0 kg/ha. This performance is comparable to that of a fertilization approach using 75% RDN and 25% N from poultry manure, which resulted in grain yields of 2,405 kg/ha and straw yields of 4,733 kg/ha.

8.	Agri-horticulture system	Mango and Curryleaf	Sorghum, Bajra, Castor, Horsegram, Blackgram, Guargum, and Marry gold	Marigold achieved an impressive flower yield of 1,960 kg/ha, leading to net returns of Rs. 49,200 per hectare. In comparison, Cowpea produced 1,280 kg/ha, with net returns of Rs. 40,960 per hectare for the year.
9.	Agri-silviculture system	Tamarind	Hedge (Henna)	The raw pod yield was 2,400 kg/ha whereas Henna grown in double rows yielded significantly more biomass at 7,000 kg/ha, in contrast to just 580 kg/ha from single-row cultivation.
10.	Silvi-pastoral system	*Melia dubia*	Fodder Maize and Fodder Sorghum	Fodder Maize achieved the highest fresh fodder yield at 8.42 t/ha, followed by Fodder Sorghum with a yield of 7.54 t/ha.
11.	Agri-silviculture system	*Melia azedarach*	Foxtail millet	The Highest B:C ratio recorded in bio fertilizer combination (1:1.84) followed by Poultry manure treatment (1:1.72).
12.	Horti-pastoral system	Custard apple	Anjan grass, Guinea grass and Rhodes grass	Guinea grass recorded highest herbage yield (1.45 t/ha) followed by Anjan grass (0.74 t/ha).
13.	Agri-silviculture system	Eucalyptus	Cowpea (*Vigna unguiculata*) and Fodder grasses (*Panicum maximum* and *Brachiaria ruziziensis*)	The higher net return recorded in eucalyptus based agroforestry system in 6 x 1m spacing Rs. 100262/ha as followed by 7 x 1.5m spacing Rs. 99468/ha
14.	Agri-silviculture system	Casuarina	Blackgram	The total return of Rs. 1,70,659 and net income of Rs. 77,281 were greater in paired-row agroforestry compared to the sole plantation which had a total return of Rs. 1,56,015 and net income of Rs. 62,264
15.	Agri-silviculture system	Subabul	Blackgram, Cotton and Tobacco	The highest B:C ratio of 2.58 was observed in the Subabul and blackgram agroforestry system compared to 1.90 for Subabul with cotton and 1.88 for Subabul with tobacco.

Agroforestry Systems for Andhra Pradesh

Melia based Agri-silvicultural System

Scientific name: *Melia azedarach* and *Melia dubia*

Suitable Spacing: Bund 3 m, Boundary 3 m, and Block 4 m x 4 m

Suitable Intercrops: Foxtail millets, Finger millet and Cowpea

Tree productivity : About 30.5 t/ha (crop + tree) biomass production (*Melia azedarach*) and The tree recorded 10 to 12 cubic/ft after 10 years (*Melia dubia*)

Economic Returns: The net return of tree (age 3-4 year) is Rs. 50000 per ha

Source: Handa *et al*. (2020)

Terminalia based Agri-silvicultural System

Scientific name: *Terminalia bellirica*

Suitable Spacing: 3 m x 3 m or 4 m x 4 m

Suitable Intercrops: Aloe vera

Yield: *Terminalia bellirica* seed yield could range from 4 to 5 t/ha. Aloe vera leaf yield could range from 6 to 8 t/ha and the initial Income in years: Rs. 15,000 to 20,000 per ha. After 5 years: Rs. 25,000 to 30,000 per ha

Source: Handa *et al.* (2020)

Tamarind based Agri-silvicultural System

Scientific name: *Tamarindus indica*

Suitable Spacing: 10 m x 10 m

Suitable Intercrops: Henna

Yield: The tamarind pod yield 2560kg/ha and 560 kg/ha of Henna leaves. The net returns is Rs. 42600/ha

Source: Handa *et al*. (2020)

Mango based Agri-horticultural system

Scientific name: *Mangifera indica*

Suitable Spacing: 10 m x 10 m

Suitable Intercrops: Sorghum, Safflower, Cowpea

Yield: The Sorghum yield varied 2.5 to 2.7 t/ha and Safflower 0.76t/ha and Cowpea 1.5 t/ha forage yield. The net return is Rs. 63500 /ha (from intercrop + filler crops)

Source: Handa *et al*. (2020)

Coconut based Horti-pastural System

Scientific name: *Cocos nucifera*

Suitable Spacing: 7.5 m x 7.5 m

Suitable Intercrops: Perennial fodder, Cumbu Napier hybrid grass is planted as understorey of Coconut

Economic Returns: The net return by the horticultural component (Coconut) is Rs. 55,800/acre from the 62 trees and additionally net return by the fodder is Rs. 2,16,000/ acre

Source: Handa *et al*. (2020).

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Agroforestry Business Incubation Centre

ABiC

Institute Technology Management Unit (ITMU) of CAFRI facilitates incubation of new startup/entrepreneurs and enterprises for innovation technologies by providing need based physical, technical, business and networking support, facilities and services to test and validate business ventures of the incubates in agroforestry-based enterprises. Also, the IP/deemed IP are commercialized for creating an ecosystem for entrepreneurship. ABiC activities includes thematic areas like are plant nursery; semi-processed items like juice, jam, pulp, gum & resin, etc.; tree seed marketing; timber and wood-based products; fibre and flosses; biofuels and briquettes; essential oils; mini-clonal technology and agroforestry models.

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