SUMMARY AND CONCLUSION

Agriculture is a multi-dimensional and multi-variable complex, dynamic, and diversified primary economic activity occupied a pre-eminent place in the economy of the State of Andhra Pradesh. The optimisation of agricultural resources is central to all discussions of agricultural problems and policies for the stable and prosperous agricultural economy of the State. The present study of the agricultural regions of Andhra Pradesh is designed with a specific purpose thus probably for classifying, describing and delineating of areal differences most efficiently in agricultural distributions.

The study of regionalisation of agriculture will eventually brings to lime light the regional inequalities in the complex nature of agricultural potentials and development possibilities. It is one to guide and aid towards the applied aspects and work on the development and planning strategies, besides attaching immense significance for comprehensive understanding the complex
and dynamic nature of spatial organisation of agriculture of the state. It is hoped that this diagnostic study will help to evolve prophylactic and curetive measures ultimately to improve the agricultural economy of the State. Obviously, the State of Andhra Pradesh with its diverse physical and socio-economic conditions as well as rich agricultural resources and development, has indeed provided an appropriate setting for the study. The economy of Andhra Pradesh is predominantly agricultural and the cornerstone of the economic development of the State lies in the development of the agricultural economy.

Among the four southern State, Andhra Pradesh is the only State which produces a surplus food offsetting or making good of deficit food production in other three States forming it self as buffer zone. In the country, Andhra Pradesh State is very significant both in the production of foodgrains and commercial crops like paddy, jowar, bajra, ragi, groundnut, cotton, tobacco, sugarcane and castor. The State is also rich in livestock population. More than half of the geographical area of the State is under agriculture, out of which 41 per cent of the cropped area is irrigated. It has the largest canal irrigated area in the country next to Uttar Pradesh State. Andhra Pradesh is the only State where three important rivers drain across the State, building into two major deltas and crypto delta. The drainage basins of these three river systems, namely, the Godavari, the Krishna and the Pennar cover 72.7 per cent of the total area of the State.
In addition, there are another 30 odd rivers which can be harnessed for developing irrigation and power. As much as the 70 per cent of the State work force is engaged in agriculture.

Objectives of the Study

The purpose of the study is primarily to present a framework on the systematic basis pointing out typical areas of depressed agriculture for immediate improvement. Agriculturally certain regions of Andhra Pradesh are quite prosperous while certain other regions are deplorably poor. It is essential to make an attempt to identify the agriculturally weaker areas and find out the regional disparities in varied aspects of agriculture. To fulfil this objective an attempt is made to regionalise the agriculture of the State into different forms, namely, irrigation regions, land use regions, agricultural land use efficiency regions, crop regions crop combination regions, agricultural productivity regions and livestock association regions. Such a detailed classification and regionalisation of agriculture may help to gain insights into the problems of each and individual aspect of agriculture and provides basis for sectoral planning and development.

In the present study, the spatial analysis is made at 'mandal' level for the year 1990-91. The changing patterns are examined at district level for a period of 30-years i.e., from 1960-61 to 1990-91.
Locational and Spatial Aspects of Andhra Pradesh

The present study region, Andhra Pradesh, is one of the States located in the southern India, with a total geographical area of 275045 sq. km. and a total population of 63,354,559. On the basis of topography, socio-economic development and politico-historical antecedents, the State is broadly divided into three regions, namely, the Coastal plain, Rayalaseema and Telangana. Administratively, the State is divided into 23 districts and 1104 mandals (1991).

Topographically the State is divided into three physical forms, namely, Coastal plains, Penep lain surfaces and the Eastern Ghats. Agriculturally, the Coastal plain is prosperous by virtue of its three major deltas, fertile alluvial plains and good rainfall conditions. The plateau region consists of Telangana and Rayalaseema formed with a long belt of old penep lain surfaces chiefly developed on the Archaean gneisses. It suffers from poor soils, low rainfall and scantly irrigation facilities. The Eastern Ghats are agriculturally least important, but they have some forest wealth.

The climate of Andhra Pradesh is broadly classified as Tropical Rainy and Hot Steppe. The State receives 67 per cent of rainfall from south-west monsoon and 25 per cent from north-east monsoon. There is a significant spatial variation in the distribution of rainfall as it is evident from the fact that the western Rayalaseema receive less than 60 cms. of annual rainfall.
while the north and north-eastern parts of the State receive more than 100 cms. The variability of rainfall is high in the low rainfall areas of plateau region and south Coastal plain. The water balance studies revealed that Rayalaseema and Telangana areas show higher water deficit than the Coastal plain. Droughts are the common occurrences in the State. About one-third of the geographical area of the State and one-fourth of its population come under the shadow of drought. The problem of drought in Rayalaseema, southern Telangana and south Coastal plain is really serious and detrimental to stable and prosperous agriculture. The population density of the State is 240 persons per sq. km. The Central and north Coastal districts found with higher densities of population, while the Rayalaseema and Telangana districts with low densities of population. The average literacy rate in the State is 37.59 per cent.

**Irrigation Types and Orientation**

Irrigation acts as catalytic agent for adoption of modern agro-technology and renders farming complexes more superior, stable, diversified and highly productive. The regional differences in irrigation are not uncommon in Andhra Pradesh, due to diversified terrain, climatic, edaphic and hydrological conditions. Therefore, it is essential to map the orientation of irrigation types and regionalise the intensity of irrigation for evaluating the base of productive agriculture.
Canal Irrigation: Canal irrigation is the major type of irrigation in the State accounted for 43 per cent of the total irrigated area of the State. The spread of canal irrigation confined to 50 per cent of the total mandals of the State in varied concentrations. The high and very high proportions of canal irrigated area are found in the traditional irrigated areas of Krishna and Godavari deltas as well as newly developed irrigation project areas of Nalgonda, Khammam, Nizamabad, Karimnagar, Nellore, Prakasam Kurnool and Cuddapah district. In the 30-year period between 1960-61 and 1990-91, the net increase in the canal irrigated area was about 0.97 million hectares. Further, there is an enormous scope for development of canal irrigation in the State, because only about 40 per cent of the surface water potential has been tapped for irrigation purpose and the remaining 60 per cent is yet to be utilised.

Well Irrigation: Well irrigation is the second important type of irrigation and accounted for 32.8 per cent of the total irrigated area of the State. High concentration of well irrigation is noticed in the districts of Rayalaseema and Telangana where canal irrigation is found insignificant. A tremendous development has been made in the increase of irrigated area under wells, which amounted to 1.404 million hectares or 20.7 per cent increase in the concentration in the last 30-year period. Well irrigation is more effective as a supplement and protective rather than a substitute in the plateau region.
Tank Irrigation: It is the third important type of irrigation and accounted for 20.6 per cent of the total irrigated area of the State. Tank irrigation is more prevalent in the Deccan plateau comprising of both Telangana and Rayalaseema as well as in the north Coastal plain. The topographic conditions are more favourable for construction of large number tanks in the Deccan plateau, and hence, Telangana region often described as the 'Land of Tanks'. The area under tank irrigation has shown a decrease to the tune of 0.05 million hectares or 18.5 per cent decline in the concentration. It may be noted that problems of heavy silting, improper maintenance of field channels, washing away of tank bunds during flash floods, mis-use of catchment area of tanks and conversion of some of tanks in to agricultural fields and encroachment of urban settlements etc., are responsible for shrinkage of irrigated area under tanks. There is a great need for restoration and renovation of all irrigation tanks so as to avail the runoff for optimum use in the non-canal irrigated areas of Telangana and Rayalaseema.

Intensity of Irrigation: The overall intensity of irrigation is calculated as the percentage of total irrigated area of the component areal unit. The regional variation in the intensity of irrigation undoubtedly brings out the regional disparities in the development of agriculture. High and very high intensities of irrigation are found in 27 per cent of the total mandals of the State distributed in the deltas and irrigation project areas of north-western and south-eastern parts of Telangana, south-coastal plain,
north-coastal plain and eastern part of Rayalaseema. The intensity of irrigation in the State has increased by 11.5 per cent or 1.918 million hectares during 30-year period. On an average, the annual growth rate of increase is 1.17 per cent, while it is high in Telangana (2.07%) and very low in Rayalaseema (0.23%). It has shown the considerable regional disparity in the development of irrigation in different regions of the State. There are still large areas in the plateau region where scarcity of agricultural water jeopardising the agricultural economy of the State.

Degree of Intensity of Irrigation: The degree of intensity of irrigation shows the extent of the area irrigated more than once and it is calculated as the percentage of gross irrigated area to net irrigated area. The average degree of intensity of irrigation in the State accounts for 124.7 per cent. The degree of intensity of irrigation in the State has increased by 6.1 per cent or to the tune of 0.522 million hectares. The high increase is found in deltaic districts of the Coastal plain and northern districts of Telangana. The annual growth rate of increase in area irrigated more than once is low which accounted for 0.4 per cent in the State. The high rate of increase is noticed in Telangana (0.93%), while Rayalaseema region registered with negative growth rate (-0.19%).

Orientation and Combination of Irrigation Types: The study of irrigation orientation and combination is based on the Kostrowick's method. Each one of the four types of irrigation are classified
into dominant, pre-dominant, semi-dominant and accompanying on the basis of magnitude. Combining these two aspects of irrigation various permutations and combinations of irrigation orientation are worked out for all the mandals of the State. From this study it is observed that the dominant canal (C₄), well (W₄) and tank (T₄) irrigation, pre-dominant canal (C₃) and well (W₃) irrigation, pre-dominant canal irrigation with accompanying well irrigation (C₃+W₁); pre-dominant well irrigation with tank irrigation (W₃+T₁); pre-dominant tank irrigation with accompanying well irrigation (T₃+W₁) and semi-dominant both well and tank irrigation (W₂+T₂ and T₂+W₂) are the most important irrigation combinations overwhelmingly dominated the irrigation scenario of the State. It indicates that the development of canal irrigation is highly localised to major river basins and flood plains. In contrast to this, the exploitation of ground water resources for the development of well irrigation is more ubiquitous and wide spread but highly inverteble in most of the dry areas of plateau region and in the uplands of the Coastal plain.

Till so far what-ever the developments made in irrigation was by and large confined to deltas and major river basins. Now what is more required for stable and prosperous agriculture in scantly irrigated areas of the State is to harness effectively the surface flow of the medium and minor river basins in the plateau region and extend the development of canal irrigation into widespread rather than intensification and localisation.
If the total surface and sub-surface water is effectively tapped, the present status of irrigation in the State can be raised to two-folds. Hence, it is the prime need to pay more attention on water management and irrigation development in the scantly irrigated areas of plateau region.

**Land Use Pattern and Land Use Combinations**

The optimum utilisation of land resource and land use management fulfilling the dual objectives of economy and ecology is becoming one of the most complex expressions of human activity performed in the sphere of man-environment interaction. The ever-increasing pressure of population and decreasing man-land ratio, on one side and ecological problems on the other side posing challenging problems as how to use land resource at optimum level to maintain proper equilibrium between the environment and the socio-economic needs.

The present study of land use pattern and land use combinations in Andhra Pradesh is accomplished on the basis of nine-fold land use classification. These nine categories are re-grouped into five major land use classes, namely (i) forest cover, (ii) non-cultivable land, (iii) other uncultivated land, (iv) fallow land and (v) net area sown.

**Forest Cover:** In Andhra Pradesh, the importance of forest land use stands next only to arable land. It accounted for 22.8 per cent of the total geographical area of the State. Conservation of
forest is of paramount importance not only promotes the soil conservation in the catchment areas, regulates runoff and improves soil moisture to maintain ecological balance but also produces handsome revenue from its wealth. The need for proper conservation and management of the forest cannot be over emphasised. 'Afforestation' is as important as the 'Green Revolution' in agriculture.

The distribution of forest cover in the State is uneven. Srisailam mandal in Kurnool district accounts for 96.8 per cent of its geographical area under forest, while a number of mandals (345 mandals) mostly located in the Coastal plain do not have even a semblance of forest. Only 16.7 per cent of the total mandals of the State have high forest cover of more than 30 per cent. The districts which have considerable forest cover are Khammam (47.9%), Adilabad (43.2%), Visakhapatnam (42.1%), Cuddapah (32.9%) and Chittoor (30.2%). The increase in the proportion of forest cover in the State is rather marginal (1.4%) amounted to 0.433 million hectares. It may be noted that the present forest (22.8%) cover is too short to fulfil the optimum requirement of 33 per cent to maintain ecological balance in the State. Much has to be done not only o increase the forest cover in the State but also to improve the quality of it.

Non-Cultivable Land: The non-cultivable land in the State accounted for 16 per cent of the total geographical area. The high proportion non-cultivable land of more than 20 per cent is found
27.7 (306 mandals) per cent of the total mandals of the State. These mandals are located in Hyderabad, Nellore, Cuddapah, Vijayanagaram, Visakhapatnam, Krishna and Chittoor districts. The non-cultivable land of the State has increased by 0.7 per cent and amounted to 0.214 million hectares. Much of the increase is due to urban spread, mining, quarrying, erosion, dumping of mineral and industrial waste, heaps, and irrigation channels etc. The expansion of non-agricultural land is being associated with both constructive and destructive aspects. There should be some rationalisation and systematic view while developing non-agricultural activities at the cost of other land uses especially forest and agricultural land. To the maximum possible extent, priority should be given to unproductive lands for non-agricultural development activities.

Other Uncultivated Land: The area under other uncultivated land accounted for 6.9 per cent of the geographical area of the State. The significant proportions of more than 10 per cent of other uncultivated land is found in 247 mandals distributed in West Godavari, Nellore, Ranga Reddy, Guntur, Prakasam, Nalgonda and Medak districts. The percentage of this land cover has decreased by 4.5 per cent amounted to 1.239 million hectares. Surprisingly the decrease in the proportion of other uncultivated land is not correlative to the increase in the proportion of arable land in the State, and hence, much of this land cover has been converted to different landuses namely, forests, non-agricultural use and fallows.
Fallow Land: The area under fallows accounted for 13.9 per cent of the geographical area of the State. The higher concentrations of fallow cover are noticed in Rayalaseem and Telangana. Here, the low and precarious rainfall conditions; poor edaphic conditions and low irrigation facilities and poor socio-economic conditions of the people are really detrimental factors for effective utilisation of fallow lands. The area under fallows increased to the tune of 0.51 million hectares or 1.6 per cent. The increase in fallow cover is found in Telangana and Rayalaseema districts. It truly indicates that the increase of fallow cover is not a positive sign of optimisation of agricultural land resource in the State. It is to be seriously viewed and concerted efforts on the lines of dry farming technology, soil and water management, multi-tier sylvi-agri-pastoral vegetative systems are to be initiated for the improvement of the potentiality of fallow cover for productive purpose.

Net Area Sown: The area under arable land accounted for 40.4 per cent of the geographical area of the State. There is a spectacular spatial variation in the distribution of net area sown ranging from a maximum of 92 per cent in Parchur mandal of Prakasam district to a minimum of 1.8 per cent in Musheerabad mandal of Hyderabad district. Moderate to very high proportions of net area sown are found in 692 mandals distributed in the deltas, river basins, coastal plains and in the fertile soil regions of West Godavari, East Godavari, Krishna, Guntur, Anantapur, Kurnool and Mahabubnagar districts. The area under arable land
has increased by 0.8 per cent amounting to 0.238 million hectares. The serious problem which is conspicuous in drought prone areas and low irrigated areas is striking fluctuation and disturbances in effective utilisation of this land use type. The State has an ample scope for further horizontal expansion of arable land through scientific methods of reclamation and colonisation of fallow cover.

**Intensity of Cropping:** The ratio between the gross sown area and net sown area is termed as intensity of cropping. The intensity of cropping in Andhra Pradesh is about 119.7 per cent. Moderate to very high intensity of cropping of more than 120 per cent is found in 418 mandals, out of them 235 mandals are located in the Coastal plain, 155 in Telangana and 28 in Rayalaseema. The Central coastal districts are very significant for high intensity of cropping due to high development of irrigation. The intensity of cropping has increased by 10.1 per cent which was to the tune of 1.139 million hectares.

**Land Use Orientation and Combinations:** The study of land use orientation and combinations is based on Kostrowick's method. The agricultural land forms the major land use category of land use combinations, which of prime importance. As a first ranking land use type, the agriculture land formed 36 different land use combinations found in 75.5 per cent of the total mandals of the State. Its concentration is overwhelmingly dominant in Coastal plain rather than plateau region. The second important land use type both in the intensity and spread is forest cover mostly
confined to, defined belts of Eastern Ghats and very high rainfall areas of northern part of the State. Fallow cover is the most typical land use type of dry areas of Telangana and Rayalaseema. The spatial spread of non-cultivable land is mostly confined to the Coastal plain, because of dense distribution of settlements, water bodies, communication structures and industrial establishments etc., Intermixed land use combinations by and large situated in upland areas and dry areas of plateau region and south Coastal plain, where heterogeneous physical conditions mostly prevail.

The changing pattern of land use analysis as revealed that the relatively stable land use pattern is found in many of the Coastal districts which is due to development of assured water facilities and favourable physico-socio-economic conditions. Any significant change which is amounted in the districts of Coastal plain is probably due to colonisation and reclamation of agricultural lands and development of non-agricultural activities as well as forest eco-systems. In contrast to this, high magnitude of dynamism in land use pattern is noticed in Telangana and Rayalaseema regions where the land use types especially related to agriculture (net area sown, fallow cover, and other un-cultivated land) have always been disturbing and fluctuating due to vagaries of monsoons, low development of irrigation, unfavourable physical environment and poor socio-economic conditions.
Agricultural Land Use Efficiency Regions

Agricultural land use efficiency is a complex and dynamic attribute of a land which provides a conceptual framework to understand the agricultural land use and evaluate its overall performance. It is an integrated system and the product of both natural and agro-technological factors. Such a study is of paramount importance in identifying the weaker efficiency areas and ultimately it aids in scientific agricultural land use planning.

Agricultural land use efficiency of Andhra Pradesh is quantified on the basis of 'Standard Coefficient Method' of Reddy and Ramanaiah (1985). For evaluating the agricultural land use efficiency, 10 variables are considered. They are (i) net area sown, (ii) area sown more than once, (iii) intensity of irrigation (iv) area irrigated more than once, (v) canal irrigation, (vi) paddy cultivation, (vii) commercial cropping, (viii) non-cultivated land (ix) other uncultivated land and (x) fallow cover. The first seven variables are positive indicators and the last three are negative.

In 1990-91, there were 46 mandals under very high agricultural land use efficiency category, 77 mandals under high agricultural land use efficiency, 207 mandals under moderate efficiency, 482 mandals under low efficiency, while 292 mandals were under very low efficiency category. It has revealed that about 80 per cent of the total mandals of Telangana and
Rayalaseema were found under low and very low efficiency categories. In contrast to this, only 45 per cent of the total mandals of the Coastal plain were noticed under these low and very low efficiency categories. It may be noted that whatever the achievements made in intensification and modernisation of agriculture have more or less confined to few agricultural pockets and neglected the most part of the plateau region. Some of the agro-technological measures taken in the plateau region could not overcome the severity of drought and finally resulted into unstable and low efficiency areas in terms of agricultural development.

In the 30-year period, the State has registered an impressive progress in agricultural land use management. The improvement in agricultural land use efficiency made in all the districts but in varied levels. Significant increase of agricultural land use efficiency are observed in the districts of Telangana and Coastal plain. The development of irrigation through commission of new irrigated projects has brought a considerable progress in optimum utilisation of agricultural land resource in Telangana districts. All the Rayalaseema districts and north coastal districts (Srikakulam, Visakhapatnam, Vijayanagaram) were not benefited much from the development of irrigation, intensification and modernisation of agriculture. Much could be done to improve the utilisation of agricultural land in the drought prone areas and low irrigated areas and a serious thought must put on popularisation of dry farming technology and soil and water management practices.
Changing Spatial Pattern of Cropping

Cropping pattern represents the spatial crop sequence and hierarchical arrangement in a given area and in a given point of time. A systematic study of cropping pattern helps to provide a comprehensive picture of crop scenario of the State. It also regionalise the agriculture which in term forms the scientific basis for allocation of agricultural land resources in a rational manner for maximum productivity.

A detailed study of all the important crops is made at mandal level for the year 1990-91 and the changes are examined at district level between 1960-61 and 1990-91.

Paddy: Paddy is the most important and extensively grown crop in the State accounting for 30.6 per cent of the total cropped area. About 368 mandals in the State have a concentration of more than 40 per cent of the gross cropped area under paddy cultivation. Out of them, 220 mandals are located in the Coastal plain, 124 in Telangana and 24 mandals in Rayalaseema. The Krishna, Godavari and Pennar deltas in particular and the Coastal plain in general have the heaviest concentrations of paddy cultivation. The area under paddy increased by 5.6 per cent amounting to 1.075 million hectares. Many of Telangana districts have registered fairly significant increase in the area under paddy which is due to development of canal irrigation by new irrigation projects. The average annual rate of increase in paddy crop area is 0.69
per cent, while it is high in Telangana (1.15%) and low in the Coastal plain (0.79%). Rayalaseema region has registered a negative growth rate of -0.78 per cent. It is advisable to take measures to improve the paddy yields rather than going for spatial expansion. Demand for water for paddy crop is rather exacting during rabi. Hence, it is economical to grow other remunerative crops like pulses and oil seeds which require less water than paddy during rabi when the water is scarce, which in turn promotes many-fold improvements in soil fertility, intensity of cropping, economisation of water and increase of productivity per unit of land and water.

**Jowar:** Jowar is the second most important cereal in the State, but a poor second one. It is basically a rained crop, eminently suitable for cultivation in dry area under low rainfall, poor edaphic and drought-prone conditions. About 9 per cent of the total cropped area in the State is under jowar cultivation. Jowar cultivation of more than 50 per cent is found in 71 mandals out of them, 211 mandals are located in Telangana, 39 mandals in Rayalaseema and 11 mandals in the Coastal plain. It has indicated that jowar is the important crop of Telangana region. The percentage of jowar area in the State has decreased by 14.1 per cent amounting to 1.54 million hectares. It has declined at the rate of 1.84 per cent per annum. The trend of decrease in jowar area is found in all the districts of the State. The general decrease in jowar cultivation is due to (i) change in the dietary aspects of the people, (ii) stiff competition from oil seeds,
cotton, tobacco and maize, (iii) development of irrigation and (iv) the crop still suffering from low per hectare yields.

**Bajra:** It is cultivated mostly in low rainfall areas as a rotation crop. Bajra cultivation accounted for 1.7 per cent of the total cropped area of the State. The crop is predominantly grown in Visakhapatnam, Nalgonda, Prakasam, Mahabubnagar and Kurnool which together accounted for about three-fourths of the total area under bajra in the State. The concentration of bajra cultivation has decreased by 3.5 per cent amounting to 0.435 million hectares. The rate of decrease is -2.28 per cent per annum. The crop is facing severe competition from oil seeds. However, under light irrigation, hybrid bajra has become popular in different parts of the State.

**Ragi:** The cultivation of ragi is not wide-spread in the State. It accounted for 1.2 per cent of the total cropped area of the State. Srikakulam, Vijayanagaram, Visakhapatnam, Anantapur, Chittoor and Mahabubnagar districts are important for ragi cultivation which together accounted for 85 per cent of ragi area. The percentage of ragi cultivation has decreased by 1.8 per cent amounting to 0.189 million hectares. The rate of decrease is -1.87 per cent per annum in the State.

**Maize:** Maize is the second most important millet crop next to jowar in the State. Its cultivation accounts for 2.3 per cent of the total cropped area. Spatially, it is highly localised to northern Telangana. It is evident from the fact that out of
100 mandals of high concentration of maize, 96 mandals are situated in the form of large contiguous cluster in northern Telangana. The proportion of maize cultivation has increased by 0.8 per cent. The annual rate of increase is 1.59 per cent in the State. Since it is a short-growing commercial crop which could be cultivated both under rainfed and light irrigation conditions, it has shown a continuous increase in the areal extent. A high yielding maize must find a suitable place in the cropping pattern of the State as it will be a profitable venture.

**Small Millets:** Small millets referred to korra, varagu and samai etc., together accounted for 1.4 per cent of the total cultivated areas of the State. But many of them assume local importance. The rain-shadow area of Kurnool, Anantapur, Mahabubnagar, Prakasam, Visakhapatnam and Vijayanagaram districts are important for small millet cultivation which together accounted for 92 per cent of the total area under small millets. The proportion of area under small millets has recorded a rapid decline of 7.3 per cent. Obviously, due to low dietary preference and low productive value, of the crop, it is being gradually eliminated from the cropping pattern of the State.

**Pulses and Grams:** The importance of pulses and grams lies in their high nutritive value both as a human diet and cattle feed. They are the chief rotative crops as well as inter-culture crops cultivated both under rainfed and irrigated conditions. Pulses and grams accounted for 12.1 per cent of the total cropped area
in the State. The important districts for cultivation of grams and pulses are Krishna, Khammam, Guntur, Karimnagar, East Godavari, Adilabad, Medak, Vijayanagaram and Warangal. The concentration of pulses and grams increased by 1.5 per cent. The annual rate of increase is 0.55 per cent in the State. It found that the area under pulses and grams has gained significance but however suffering from striking fluctuations. It became a chief rotative crop in the paddy fallows of the Coastal plain during rabi season.

**Sugarcane:** Sugarcane area accounted for 1.4 per cent of the total cropped area in the State. Visakhapatnam, East Godavari, West Godavari, Krishna, Chittoor and Nizamabad districts together accounted for 82 per cent of the total sugarcane area. The proportion of area under sugarcane has increased by 0.7 per cent and it is at the growth rate of 1.6 per cent per annum. It may be stated that there has been a favourable trend for increase of sugarcane cultivation due to development of irrigation, favourable market and establishment of new sugar factories at different locations.

**Groundnut:** Groundnut is an important commercial oil seed crop extensively grown in the State. Next to paddy, it is the second most important crop in the cropping pattern of the State and accounting for 18.1 per cent of the total cropped area. The cultivation of groundnut is spectacular in Rayalaseema region which alone accounted for 65 per cent of the total groundnut cultivated
area. The concentration of groundnut cultivation has significantly increased by 11.4 per cent amounting to 1.592 million hectares which is a three-fold increase. It is increased at the rate of 2.46 per cent per annum in the State. Groundnut cultivation is highly favoured by the farmers of upland areas and drought-prone areas of the State because of the following reasons: (i) it is a cash crop which can be cultivated in dry areas, (ii) by all means it fetches good income than the cultivation of other dry crops, (iii) it is a short-growing crop which can even withstand for short dry spells, (iv) it requires less water than any other irrigated crop, (v) the cost of its cultivation is moderate, (vi) the operations of its cultivation are very easy, (vii) it is less labour intensive, (viii) it is less disease-prone, (ix) different types of red and mixed red and black soils are more suitable as it can be cultivated on undulating terrains, and (x) it has good market and price value. In the recent years, groundnut crop in Andhra Pradesh has become the most competitive crop both for wet and dry crops and has tended to replace foodgrain crops. In some areas some of the minor millets are getting eliminated from the cropping pattern due to spatial spread of groundnut cultivation.

Cotton: The cultivation of cotton accounted for 5.0 per cent of the total cultivated area of the State. It is mostly raised as a rainfed crop in black deep medium soils. Guntur, Adilabad, Kurnool, Warangal and Prakasam districts are important for cotton
cultivation which together accounted for about three-fourths of the total cotton cultivated area. The concentration of cotton cultivation has increased by 2.5 per cent and this increase is at the growth rate of 1.87 per cent per annum in the State. If some of the following factors are eliminated, cotton cultivation receives marked attention in the State (i) low per-hectare yield, (ii) lack of irrigation facilities, (ii) adverse effects of cyclones, droughts, and prolonged dry spells, (iv) wide-spread crop diseases and (v) fluctuation in price structure and marketing.

**Tobacco:** Andhra Pradesh is famous for tobacco cultivation. Its cultivation accounted for 1.3 per cent of the total cropped area in the State. East Godavari, West Godavari, Krishna, Guntur, Prakasam, Nellore, Kurnool, Manabubnagar, Khammam districts are important for tobacco cultivation, which together accounted for 93 per cent of the total area under the crop. The concentration of tobacco cultivation has increased by 0.1 per cent. But the growth rates and regression trends revealed that there is a trend of decrease in tobacco area at the rate of -0.37 per cent per annum in the State. It is due to the vulnerable price fluctuations, market facilities and Government policies. The efforts of the Tobacco Board in the State to improve the market condition and price structure have not fully fructified yet.

From the analysis of cropping pattern it is inferred that the cropping pattern of the State is complex, dynamic and diversified due to bewildering diversity in physical conditions
as well as dynamic socio-economic, technological and political factors. The present crop scenario of Andhra Pradesh, is dominated by paddy, jowar and pulses and grams from the point of foodgrain cropping and oil seeds from the point of commercial cropping.

Crop Regionalisation and Crop Combination Regions

It has often been found that crops are the principle index of agricultural typology and so much so the process of agricultural regionalisation was intimately connected with crop regionalisation. Crop combination analysis aims to bring to light the dominant crops and eliminates minor crops from the complex cropping pattern. Such a study helps to understand the crop eco-system of the region and aids in regional agriculture planning to optimise crop farming. The present study is based on delimiting the crop regions on the basis of first, second and third ranking crops, as well as identifying the crop combination regions on the basis of Doi's method. The crop diversification is quantified with the help of Gribbs-Martin index.

Crop Regions: The study of crop regionalisation has revealed that there are 16 primary crop regions, 20 secondary crop regions and 19 tertiary crop regions in the State. This has manifested the bewildering diversity in agricultural distributions as a response to diversified physical, socio-economic, demographic and technological factors. However, the striking characteristic feature of primary crop production is dominated by foodgrain crops spread
over 71 per cent of the total mandals of the State. It reflects the main function of cultivation in the State as primarily characterised by sole reliance on subsistence foodgrain oriented farming and economy. The significance of primary commercial orientation of farming and economy is more apparent in upland areas of the Coastal plain and dry area of the plateau region.

The distribution of crop regions as represented by first rank, second rank and third rank crops vividly brought out regional differences to a greater extent. The areas of extreme agro-geographic conditions are found with exclusively a very fewer number of crops. For instance the large contiguous paddy region confined to favourable Coastal plains where as large contiguous groundnut region attached to deplorably poor western Rayalaseema. The intermediate areas are grown with variety of crops and formed small agricultural regions. Paddy, groundnut, pulses and grams and jowar are the major crops involved in crop regionalisation in different parts of the State. Paddy is the most leading crop in the State. And by all the ways (as a first rank, second rank and third rank crop) it is grown in 959 mandals which account for 87 per cent of the total mandals of the State. In a similar manner it is followed by groundnut spread over to 549 mandals, pulses and grams 508 mandals and jowar 359 mandals.

There has been a significant crop transformation in establishing and stabilising crop regions at primary, secondary and tertiary levels. Paddy cultivation holding either as first
rank, second rank or third rank crop has occupied and increased from 15 districts in 1960-61 to 23 districts in 1990-91. In similar way groundnut has increased from four districts to ten districts; maize from nil to three districts, fruits from two to four districts; cotton from one to two districts and tobacco, sugarcane and castor from nil to one district. In contrast to this, millet crops have significantly lost their areal importance in forming the crop regions which is mainly due to competition arised from oil seeds, fruits and cotton as well as change in the socio-economic needs of the people. It is pertinent to State that there has been an apparent increase in the diversification of cropping especially at secondary and tertiary crop levels which is due to competition between foodgrains, oil seeds, fruits and other dry commercial crops. This is a good sign indeed for crop rotation and optimisation as well as economic development of agricultural land resources in the State.

**Crop Combination Regions:** There are seven-crop combinations identified in the State. A careful analysis of the crop combination has revealed the following:

1. The crops exerting a powerful influence to make cultivation a mono-culture are paddy, groundnut, jowar, cotton and fodder crops. Among them, paddy is overwhelmingly the leading mono-culture crop occupied 135 mandals followed by groundnut 75 mandals, jowar 3 mandals, cotton and fodder crop one mandal each.
2. The crop combinations with less number of crops as well as specialisation of crops are mostly found in Coastal plains, irrigated areas, river valleys and extremely in high rainfall regions or very low rainfall regions. In contrast, more diversification and combinations with more number of crops are mostly prevalent in the dry uplands, rainfed areas and scantily irrigated regions of the State.

3. The crop combinations with a fewer crops i.e., one-crop, two-crop and three-crop are far more prevalent than too many multiple crop combinations. Crop combinations with a lesser number of crops are found in much larger number of mandals as well as in spatial contiguity. In contrast, the crop combinations with larger number of crops are not only limited in their areal spread but also highly scattered in their distribution and isolated in location. This tendency has shown as increase with the increase in the number of crops in the combinations.

4. It may be noted that in the process of crop transformation and competition existed, between foodgrain and commercial crops, some of the inferior crops like millets, have lost their significance and some of the commercial and high remunerative value crops like paddy, groundnut, pulses, maize, cotton etc., have consolidated their spatial extent. As a result, the degree of crop diversification has been reduced in the hypermultiple crop combinations.
5. The traditional mono-crop growing deltaic districts were also involved in crop transformation by cultivating different crops in combination due to the adoption of scientific land use management practices.

6. The spectacular spatial spread of groundnut cultivation in Rayalaseema has replaced the millet crops from combination types and as a result, the cropping in this region is tending towards more specialisation.

7. The development of new irrigated areas in the districts of northern Telangana brought about a significant change in association and relative ranking of crops in the combinations. Here paddy, maize and groundnut became competitive crops to millet crops.

8. A dynamic feature in the crop associations of the State has been the shift, from subsistence foodgrain crops to commercial crops like oil seeds, fruits, cotton etc.

9. As the process of change in cropping pattern is progressed a greater degree of uniformity and stability are brought about in the crop farming economy of the State.

Regionalisation of Agricultural Productivity

On the basis of agricultural productivity an attempt is made to develop regionalisation. Such a study highlights (i) the changing pattern of yield levels of important crops, (ii) the
hierarchy of agricultural productivity regions, and (iii) changing levels of agricultural productivity.

Changing Pattern of Crop Yield Levels: The analysis of changing patterns, growth rates and regression trends of the yield levels of important crops has revealed the following:

1. All the crops except sugarcane have registered an increase in the yield levels but in varied proportions.

2. An impressive progress in the yield levels is brought in few crops namely, paddy, cotton and maize.

3. The strategy of 'Green Revolution' has led to the emergence of paddy cultivation only. To some extent the modernisation of agriculture has brought some significant impact on cotton and maize yield levels. Though all the rainfed crops were witnessed with some progress in the yield levels but heavily suffering from striking disturbances and fluctuations. The changing trend pattern in the yields of rainfed crops is though dynamic and positive but not healthy, stable and developed. Therefore, the yield levels of rainfed crops are suffering from high degree of instability.

4. Among the three regions, the Coastal plain has been emerged as healthy, dynamic and developed region in Andhra Pradesh with high growth rates and little fluctuations in yield levels of all the crops.
5. Inter-district disparities in yield levels are less significant in the case of irrigated crops like paddy and sugarcane, while the disparities in yield levels of rainfed crops are significantly high.

6. During the 30-year period, the declining trend in disparities of yield levels is found in paddy, sugarcane, groundnut, tobacco, cotton, ragi and green gram, while in the other crops like jowar, bajra, maize, black gram, red gram and horse gram, the disparities in yield levels are further accentuated.

Aggregate Agricultural Productivity: The aggregate agricultural productivity is measured in terms of money-value coefficients of 18 important crops. On the basis of agricultural productivity, five productivity regions are demarcated and delineated.

The region with very high agricultural productivity comprises of six districts namely, East Godavari, West Godavari, Krishna, Guntur and Nellore of the Coastal plain and Chittoor district of Rayalaseema. This region is agriculturally the most prosperous and dynamic. The region with high productivity comprises three districts namely Nizamabad and Karimnagar districts of Telangana and Prakasam district of Coastal plain. The development of both canal irrigation, well irrigation made the agriculture more stable and prosperous in the two Telangana districts. The region with moderate agriculture productivity comprises 5 districts namely, Khammam and Warangal of Telangana; Visakhapatnam and
Vijayanagaram of Coastal plain and Cuddapah district of Rayalaseema region. The region with low agricultural productivity includes 5 districts namely, Medak and Nalgonda of Telangana, Kurnool and Anantapur of Rayalaseema and Srikakulam district of the Coastal plain. Different factors are responsible in different districts for the present agricultural situation in this region. With the expansion of canal irrigation facilities which is likely possible, this region is likely to make significant advances in productivity of agriculture. The region with very low agricultural productivity is obviously least developed. It comprises Adilabad, Ranga Reddy and Mahabubnagar districts of Telangana region. The agricultural productivity of this region is largely being conditioned by environmental constraints of striking severity and low development of irrigation and intensification of agriculture. In this region the farming is mostly rainfed and diversified and precarious too. The agricultural productivity of this region can be improved to considerable extent by developing irrigation potential and dry farming technology.

The study of changing pattern of agricultural productivity in terms of money-value coefficients has provided interesting results in the process of agricultural development of the State. They are:

1. Both in the first teriennium and the last teriennium, the high productivity of agriculture has shown by the Coastal districts. It indicates that in the process of
modernisation of agriculture, many of the Coastal districts have further shown rapid progress in achieving higher productivity levels.

2. Though all districts of the State registered progress in agricultural productivity, the greater instability of agricultural productivity is apparent in the districts of Rayalaseema and Telangana. For instance, Kurnool district of Rayalaseema came under the low productivity category in 1960-63 and 1970-73 and it moved beneath the moderate productivity category in 1980-83, while in 1989-92, the district pushed back to low productivity category. The same was with the Adilabad district too.

3. In Telangana region, Nizamabad, and Karimnagar districts have made tremendous improvement in agricultural productivity for the last one decade which is due to development of irrigation and modernisation of agriculture. Warangal and Khammam districts also have made significant progress even under severe environmental constraints.

4. Some of the non-canal irrigated districts mainly Chittoor and part of Nellore, Prakasam and Cuddapah have also made considerable progress in improving their agricultural productivity by cultivating commercial crops.
like groundnut, cotton and tobacco at extensive level and paddy and sugarcane at intensive level under the practices of modernisation of agriculture.

5. During the 30-year period, with the increase of commercialisation, highly income-based irrigated-new-seed-fertiliser-mechanised technology and intensification of agriculture, the inter-regional disparities in levels of agricultural development have increased considerably in the State, which is of course sometimes inevitable and natural but not healthy and progressive for balanced regional agricultural development in the State.

Livestock Association Regions

Structurally livestock are part and parcel of agriculture, but productionally the most neglected branch of agricultural economy of the State. Today mixed farming and diversification of agriculture are recognised as essential modifications to be brought about to vitalise the small scale agricultural economy of the drought-prone areas of the State.

In order to make accurate comparisons in the distribution of different categories of livestock, the absolute numbers of livestock were converted into livestock units on the basis of animal feed unit developed by Indian Council of Agricultural Research, 1971.
Cattle: Cattle includes both cows and bullocks accounted for 54.2 per cent of the total livestock units in the State. High and very high concentrations of cattle units are found in 262 mandals distributed mostly in the interior parts of the State. Cattle are the chief source of energy in agriculture and they regarded as the consummation of regional agriculture.

Buffaloes: Buffaloes constitute the second most important category of livestock and accounted for 33.4 per cent of the total livestock units of the State. Buffaloes thrive well in the humid and sub-humid climatic conditions, and in the areas where water conditions are congenial and hence their concentration was pre-dominantly confined to Coastal areas. Buffaloes are the major source of milk production in the State.

Draught Force: Draught Force consists bullocks and he-buffaloes, which are used in agricultural operation. Draught force accounted for 35.5 per cent of the total livestock units in the State. Moderate to high concentrations of draught force are found in 457 mandals mostly distributed in the plateau region, where the rainfed farming heavily depends upon animal power.

Milch Stock: Milch stock includes cows and she-buffaloes, which accounted for 26.2 per cent of the total livestock units in the State. High concentration of milch stock is found in 296 mandals, of them, 228 mandals are located in the Coastal plain, 43 mandals in Telangana and 25 mandals in Rayalaseema. Since she-buffalo
is considered as the main milk yielding animal, the Coastal plains are identified as the main areas of milk production.

**Sheep and Goat:** Sheep units accounted for 5.6 per cent of the total livestock units of the State. Sheep are more suited to dry climatic conditions and hence their concentration is higher in Rayalaseema and southern part of Telangna. Goat units accounted for 3.7 per cent of the total livestock units of the State. The high concentration of goat is also found in the rainshadow region of Rayalaseema and Eastern Ghat portion of south Coastal plain.

**Livestock Association Regions:** The livestock association regions are identified on the basis of Doi's method. There are five major types of livestock association regions identified in the State. The distributional pattern of livestock associations revealed that mono-livestock association is found in 11 mandals, two-livestock association in 176 mandals, three-livestock association in 853 mandals, four livestock association in 62 mandals and five-livestock association in 2 mandals. Draught force, milch stock and other bovines are figured in most of the different types of livestock associations. Diversified livestock associations are frequent in Rayalaseema and south Coastal Andhra.

Since crop husbandry is unstable, unprotective and unproductive in most of the rainshadow areas of the plateau region, animal husbandry has to be excogitated as an alternative possible primary occupation to improve the economy of the agriculturally
backward areas. An agriculture planning aiming at greater diversification of agriculture will certainly offset some of the risks involved in specialisation and mono-culture farming. Here the concepts of 'Green Revolution' and 'White Revolution' are to be placed more or less on equal plane and both the twins must be made to travel together to achieve the noble destination of the rural economic uplift and balanced regional agricultural development in the State. Any official agricultural policy of the State or Centre may be designed to encourage such a trend of agricultural diversification.

CONCLUSION

In conclusion, it may be noted that Andhra Pradesh has made an impressive progress in achieving significant agricultural development. But in the true sense, the development in agriculture has not been made in conformity with all the areas and all the crops. The strategy of Green Revolution and modernisation of agriculture have led to the emergence of few agricultural centres into healthy, dynamic and developed areas. Among the crops, paddy has claimed an unrivalled and assumed the pride of place in agricultural productivity of the State relegating all other crops to a position of poor secondary importance. The fruits of this revolution remains many areas in the plateau region into stagnant and into most blighted condition in the race of agricultural growth. Inter-regional disparities in levels of agricultural development have increased significantly and provided
the basic stratum on which the structure of horizontal inequities of the State essentially rests.

Pragmatically, the agricultural growth is not continuous but highly disturbing in low rainfall and scantily irrigated parts of Telangana, Rayalaseema and south Coastal plain. In these areas, uncertain water supplies, severe environmental constraints and high degree of risk kept the levels of adoption of technology and yield levels of many crops at low and stagnating but at the best runs in a disturbed fashion. Here, only one crop can be taken and even sometimes that crop is only sufficient to meet the cost of harvesting. These weaker areas present more or less static agricultural environment where net cultivated area is always high but in fluctuating stage, fallow and culturable waste-lands are in high proportion and forest cover is very low which speak the delicate, disturbed and vulnerable land use system. Despite many policies and programmes initiated, the land use system of dry areas of the State could not receive due attention at priority level.

The most important and essential task of ecological land use planning is to gear up the processes of land and water management so that dynamic balance may be kept up in ecological system of land use with changing socio-economic needs of the region. The first and foremost initiation in this direction would be to prepare land use ecosystem maps on large scales with the help of remote sensing techniques so that perspective planning
programmes of future land uses may be designed at micro level in different parts of the State. The ecofarming will pave the better way for achieving substantial progress in utilising vast land resources at optimum and productive level in dry areas of the State. What is technologically possible must be made socially feasible and acceptable.

The important task which is ahead at both peasant and Government for further advancing the agriculture in the State implicitly concerns with the achievement of stabilisation and sustainable development in drought-prone areas. Stable and sustainable agricultural development is a complex and demanding task which not only emphasizes the need for better compatibility between environment protection and agriculture technologies but also the necessity of ensuring technological progress while providing adequate economic returns. It is possible to bring stability and sustainability in agricultural economy of the State by bringing radical changes in (i) the expansion of irrigation in drought-prone areas by conjunctive utilisation of both surface and sub-surface water resources, (ii) optimisation of cropping pattern, (iii) wide-spread diffusion and application of better soil and water conservation methods, (iv) popularisation of scientific methods of cultivations like dry farming technology, crop-rotation and multiple cropping systems, and (v) modernisation of agriculture. The Government has to concentrate on the development of minor and medium irrigation projects across the minor river basins in dry areas instead of specialising and monopolising major irrigation
systems in specific areas. Consideration and wide spread application of 'Watershed' or 'Catchment' at micro level as an indivisible unit for resource management is an essential prerequisite in scantily irrigated areas. In the operation of this endeavour, institutional help is imperative. It is clear that problems of dry land agriculture are not the ones which can be overcome by mere technological solutions but require lasting peasant outlook and institutional changes too.

The present agricultural system of the State is highly specialised in crop production but least in livestock production. The State has enormous livestock wealth. At the level of individual holding, farmers often engaged in a variety of enterprises, competitive as well as supplementing and complementary enterprises. What is more required at present in the case of small and marginal farmers in arid and semi-arid areas of the State, the factors of their production might be employed more gainfully with greater diversification which is more are less a realising process. Any institutional policy which may be designed to encourage the diversified agricultural systems, so that the location of livestock enterprises may be encouraged in all parts of the State. Even in the highly developed Coastal plains also there is no scope for further development of crop based economy and hence, livestock is the next alternative enterprise to be concentrated for all-round development of agriculture. Therefore, diversified agricultural economy is the prime need of the hour to avoid environmental and socio-economic problems created by
mono-cultures to make maximum use of available bio-diversity to adapt agriculture to the changing environments and adverse natural conditions.

It may be noted that the present agricultural economy is in the transition form subsistence agriculture to commercial farming. At this threshold, the peasant must know in advance the satisfactory price at which he could dispose of his produce. At present, the commercial specialisation in a perfectly open market system is fraught with the hazard of climatic factors and price fluctuations. As long as the small farmer is not assured of a sure price for his produce, it is difficult to achieve sustainable agriculture. In the process of agricultural change leading to the sustainable agricultural economy, active assistance of the Government becomes most helpful. In fact it becomes imperative, because the new seed-fertiliser-irrigation technology involves the use of costly inputs and the assurance for a stable and reasonable price becomes necessary for sustained agricultural production. Further, price policy serves as an important tool for facilitating crop and livestock planning. Such a policy also ensures a balance between the income of the agricultural sectors.

Apart from the institutional assistance in designing, diffusing and dedicately implementing various agricultural policies, the realisation of peasant community from traditional practices of agriculture to scientific management and development of agriculture is of paramount importance in achieving stable and
sustainable agricultural development. If all the possible technologies operate positively, still the Andhra Pradesh State has an immense agricultural potential for developing itself into a dynamic and prosperous agricultural State in India.