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IRRIGATION ORIENTATION AND COMBINATIONS IN ANDHRA PRADESH, INDIA

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ABSTRACT : The present paper attempts to analysis the orientation of irrigation types and their combinations in Andhra Pradesh State by employing Kostrowicki's method. The development of irrigation is also examined with the help of linear trends and growth rates and tested with 't' statistical test. The analysis is amde both at mandal and district levels which includes 1,104 mandals and 23 districts in the State. This paper aims at regionalising the dynamic, semi-dynamic and weaker areas in terms of irrigation development in the predominantly agricultural State of Andhra Pradesh in India.

INTRODUCTION

Irrigation is a farming practice designed to supplement deficiency arising out of excess evaporation over precipitation in a region. Where rainfall is inadequate and precarious, irrigation plays a crucial role in the process of transformation of agriculture and provides an important technological input for a stable and a sustainable agricultural development. It is pertinent to state that irrigation can do more than just support farming activities. The efficient use of water permits the application of modern agricultural practices which, altogether, used in the right combination can lead to very successful agriculture, as demonstrated by the success achieved by the use of high yielding varieties. There is an evidence to prove that farmers who are provided with irrigation facilities can innovate quickly, there is none to show the pattern followed by dry farmers (Harris, 1972).

Timely and adequate moisture supply is a sine qua non in hybrid farming and its success, therefore, is closely linked with the development of assured irrigation. Thus, irrigation acts as a catalytic agent for adoption of modern agricultural technology, namely hybridisation, mechanisation, fertiliser and plant protection application, intensification and commercialisation. Further, irrigation renders farming complexes superior, stable, diversified and highly productive.

METHODOLOGY

In the present study, the percentages of different types of irrigation are computed to the gross irrigated area of component areal unit and analysed at mandal level for the year 1990-91. The intensity of irrigation is calculated as percentage of gross irrigated area to gross sown area and regionalised. Kostrowicki's method is employed to find out the combinations of irrigation types. The changing pattern of

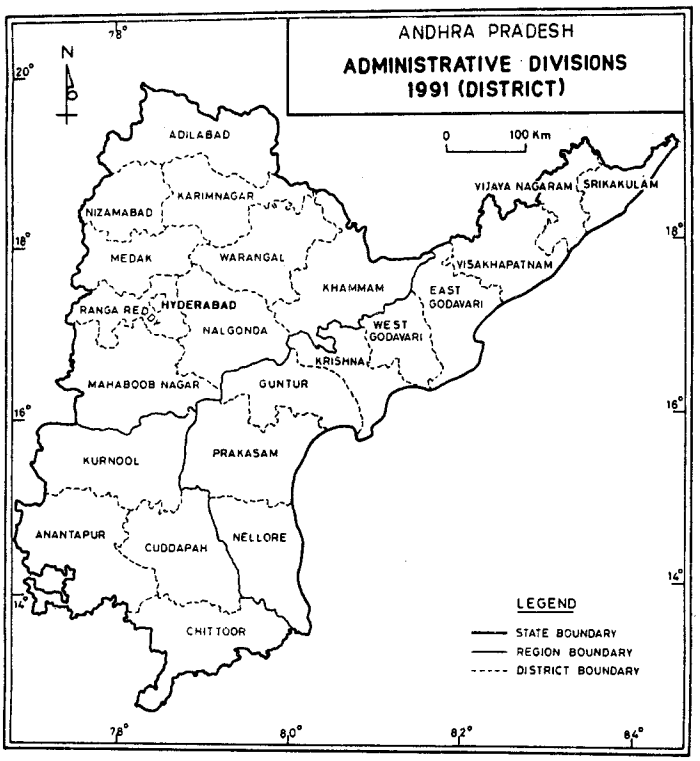

Fig. 1 : Andhra Pradesh - Administrative divisions 1991 (District)

irrigated area is also examined with the help of, linear trend equation Y = a+bx and growth rates for the last 30 years i.e. from 1961 to 1991.

Source of Irrigation in Andhra Pradesh

Canals, wells, tanks and other sources are the important types of irrigation in Andhra Pradesh. Of all these sources, canals are the most significant source of irrigation which accounted for 43 per cent of the total irrigated area of the State followed by wells 32.8 per cent, thanks 20.66 per cent and the remaining 3.6 per cent is irrigated from other sources.

Andhra Pradesh has 40 major, medium and minor river basins. The three major river systems, namely Godavari, Krishna and Pennar alone have a large irrigation potential covering 72.7 per cent of the area of the State. According to the Second Irrigation Commission Report 1972, Andhra Pradesh has an aggregate irrigation potential of about 10.32 million hectares comprising of about 6.48 million hectares of surface water under major and medium irrigation, about 2.02 million hectares under minor irrigation and about 1.82 million hectares of ground water resources. As against this potential, the gross irrigated area in Andhra Pradesh in 1990-91 was only 5.37 million hectares accounting for only 52 per cent of the total irrigation potential of the State. Thus, a very large proportion of the State's irrigation potential still remains underdeveloped.

Orientation and Combination of Irrigation Types

A study of orientation and combination of irrigation types helps to understand the

hydrological character as well as nature of agricultural scenario of an area. Orientation of irrigation in a region is conditioned by physical and socio-economic environments that exists there. The orientation of irrigation and combination of irrigation types are found out with the help of Kostrowick's (1960, 1965) method. As per this method, orientation of irrigation is classified into four types (Table-1) and the irrigation area under any irrigation type with less than 20 per cent is left out. A symbolic nomenclature is given to each irrigation type e.g.,

C = Canal, W = Well, T = Tank and O =Other Sources.

Table -1 :

Irrigation Orientation

Area in per cent	Role	Rank
> - 80	Dominant	4
60 - 80	Pre-dominant	3
40 - 60	Equi/Semi-dominant	2
20 - 40	Accompanying	1

These are grouped to form combination and these combinations are expressed in the form of formula where letters represent irrigation type and figures show their role and rank. In general irrigation orientation and combination in the State is semi-dominant canal irrigation with accompanying well and tank irrigation ($C_2+W_1+T_1$). But in the spatial distribution, irrigation orientation ranging from the dominant bases of canal, well, tank and other type of irrigation (C_4; W_4; T_4; O_4) to a mixed combination of different types of irrigation ($C_1+W_1+T_1$). There are nearly 69 different combinations of irrigation orientation found in the State.

Canal Irrigation Orientation

Andhra Pradesh ranks second among the States of the country in the hectarage of canal irrigation. Though Canal irrigation occupied a prime place in the development of irrgation in the State, its spread as a first ranking irrigation type is only secondary next to well irrigation. Its spatial spread as a first ranking irrigation type is found in 345 mandals which account for 31.3 per cent of the total mandals of the State. Here, it is emphasized that instead of spatial spread, the spatial concentration of canal irrigation is much significant as is evident from the fact that the dominant type of canal irrigation (C_4) is registered in 184 mandals and no other irrigation type claims such a spatial spread and intensity. This dominant canal irrigation is distributed overwhelmingly in Krishna and Godavari deltas as well as in the major irrigation project areas. Pre-dominant (C_3) canal irrigation is found in 29 mandals distributed mostly in the Coastal plain and north-western Telangana region (Table-2).

Pre-dominant canal irrigation with accompanying well irrigation (C_3+W_1) is found in 36 mandals distributed mostly in the K.C.Canal and Tungabhadra irrigation project areas of Kurnool and Anantapur districts, and peri-deltaic shields of the Coastal plain. Pre-dominant canal irrigation with accompanying tank irrigation (C_3+T_1) is found in 19 mandals distributed largely in north Coastal plain and north-eastern Telangana region.

Well Irrigation Orientation

In contrast to orientation of Canal irrigation, the spatial spread of well irrigation as a first ranking category of irrigation combination is very largely extended to 426 mandals which account for 38.6 per cent of the total mandals of the State. But its orientation as a dominant type (W_4) is lesser than the canal irrigation found in

Table-2

Orientation and Combination of Irrigation types in Andhra Pradesh - 1990-91

Orientation and Combination of Irrigation Type (1)	No. of Mandals (2)	Orientation and Combination of Irrigation Type (1)	No. of Mandals (2)	Orientation and Combination of Irrigation Type (1)	No. of Mandals (2)
Canal Irrigation Base		W_2+C_1	14	Other Source Base	
C_4	184	W_2+O_1	2	O_4	23
C_3	29	$W_2+C_1+T_1$	7	O_3	1
C_3+W_1	36	$W_2+T_1+C_1$	5	O_3+T_1	8
C_3+T_1	19	$W_2+T_1+O_1$	2	O_3+W_1	7
C_3+O_1	3	$W_2+O_1+T_1$	2	O_3+C_2	1
C_2+T_2	9	$W_2+O_1+C_1$	1	O_2+T_2	4
C_2+W_2	7	$W_1+T_1+C_1$	3	O_2+W_2	4
C_2+O_2	2	$W_1+C_1+T_1$	2	O_2+C_2	3
C_2+T_1	18	Tank Irrigation Base		O_2+T_1	3
C_2+W_1	13	T_4	58	O_2+W_1	3
$C_2+T_1++W_1$	10	T_3	14	$O_2+W_1+T_1$	2
$C_2+W_1+T_1$	4	T_3+W_1	66	$O_2+W_1+C_1$	1
$C_2+W_1+O_1$	2	T_3+C_1	11	$O_2+T_1+W_1$	1
$C_2+O_1+W_1$	2	T_3+O_1	5	$O_1+W_1+T_1$	1
$C_2+O_1+T_1$	1	T_2+W_2	47		
$C_1+W_1+T_1$	4	T_2+O_2	7		
$C_1+T_1+W_1$	2	T_2+C_2	5		
Well Irrigation Base		T_2+W_1	16		
W_4	125	T_2+C_1	13		
W_3	23	T_2+O_1	7		
W_3+T_1	123	$T_2+C_1+W_1$	4		
W_3+O_1	22	$T_2+W_1+C_1$	4		
W_3+C_1	8	$T_2+W_1+O_1$	3		
W_2+T_2	54	$T_2+O_1+W_1$	2		
W_2+O_2	6	$T_1+C_1+W_1$	3		
W_2+C_2	4	$T_1+C_1+O_1$	2		
W_2+T_1	23	$T_1+W_1+C_1$	2		
		$T_1+O_1+W_1$	1		

125 mandals mostly found in the plateau region comprising of southern parts of Rayalaseema the southern, southwestern and northern parts of Telangana regions.

The pre-dominant well irrigation (W_3) is found 23 mandals distributed in Prakasam, Chittor, Kurnool, Ramga Reddy, Warangal, Nalgonda and Karimnagar districts.

Pre-dominant well irrigation with accompanying tank irrigation (W_3+T_1) is another important irrigation combination found in 123 mandals mostly located in Rayalaseema and Telangana regions especially in Nalgonda, Mahabubnagar, Warangal, Nizamabad, Karimnager, Anantapur, Cuddapah and Chittoor districts. Pre-dominant well irrigation accompanying with other sources (W_3+O_1) is another significant combination found in 22 mandals located in Medak, Kurnool, chittoor and Guntur districts. Pre-dominant well irrigation with accompanying canal irrigation (W_3+C_1) if found in 8 mandals.

Tank Irrigation Orientation

As a first ranking type in all the combinations, tank irrigation accupies 271 mandals which account for 24.5 per cent of the total mandals of the State. Dominant (T_4) and Pre-dominant (T_3) tank irrigation orientations are found in 72 mandals located mostly in 58 mandals mostly in north Coastal plain and northern parts of Telangana. Pre-dominant tank irrigation with accompanying well irrigation (T_3+W_1) is a very significant combination found in 66 mandals found in southern and northern parts of Telangana, southern and northern parts of Rayalaseema and southern Coastal plain regions. Pre-dominant tank irrigation with accompanying canal irrigation (T_3+C_1) is found in 11 mandals, of which, 6 mandals are located in Vizayangaram district of north Coastal plain.

Other Sources of Irrigation Orientation

Other sources of irrigation as a first ranking category in various irrigation combinations is found in 62 mandals which account for 5.6 per cent of the total mandals of the the State. Dominant orientation of other sources of irrigation (O_4) is found in 23 mandals located mostly in the forest and hilly areas of northern parts of both Telangana and Coastal plain regions.

Regionalisation of Intensity of Irrigation

A study of the conjuctive use of both surface ad sub-surface water for irrigation as well as an aggregate use of canal, tank and well irrigation provide an overall view of the status of gross irrigation in the State. The overall intensity of irigation is calculated as the percentage of total irrigated area from all sources to the total cultivated area of the component areal unit. The regional differences in the intensity of agriculture undoubtedly bring out the regional disparities in the development of agriculture. In 1990-91, the gross irrigated land in the State by all sources formed about 41 per cent of the gross sown area of the State. However, it spatially varies from a maximum of 100 per cent in 23 mandals to minimum of 0.1 per cent in Wankadi mandal of Adilabad district. At district level the highest intensity of irrigation if found in Hyderabad (100%) while the lowest in Anantapur (15.5%).

High (60-80%) and very high (>80%) intensities of irrigation are found in 27 per cent (298 mandals) of the total mandals of the State. The larger concentrations of these intensities of irrigation are found in the pre-dominant canal irrigated areas of the deltas and major and medium irrigation project areas of north-western Telangana and south-eastern Telangana, south Coastal plain, north Coastal plain and eastern part of Rayalaseema.

A moderate (40-60%) intensity of irrigation is found in one-fifth of the total mandals of the State. The large chunks of maderate intensity of irrigation are found in the river basins of Coastal plains, pre-deltaic areas and all along the Godavari river valley of Telangana region.

Low (20-40%) intensity if irrigation is found in one-fourth (275 mandals) of the total mandals and very low intensity of irrigation (< 20) is in 28 per (309 mandals) of the total mandals of the State.

Growth in the Intensity of Irrigation

The intensity of irrigation has increased from 29 per cent in 1960-61 to 41 per cent in 1990-91 during the 30 years period. In terms of hectarage, the gross irrigated area has increased from 3.45 million hectares in1960-61 to 5.40 million hectares in 1990-91, showing a net increase of 1.95 million hectares.

The regression trend analysis has also revealed that there is an impressive trend of increase in the area under irrigation in the State. This positive trend is significantly accounted for by 69 percent co-efficient of determination. The 't-value' has also confirmed that the trend of increase is significant both at 1 per cent and 5 per cent levels of significance. A similar trend of increase is noticed in Coastal plain and Telangana regions. In the case of Rayalseema, it is perplexing to note that a jeopardizing trend of increase is found and which is accounted for by only 4 per cent of co-efficient of determination. It indicates that the present positive trend of increase is not stable. the 't-value' also revealed that this marginal trend of

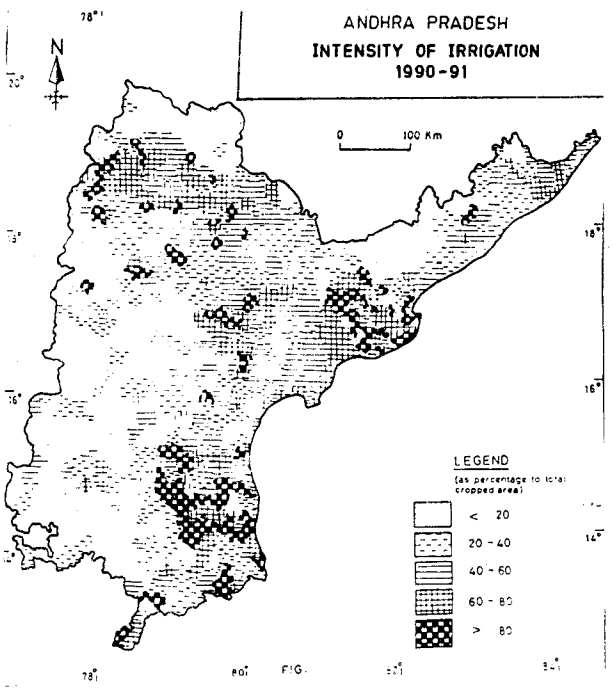

Fig. 2 : Andhra Pradesh - Intensity of Irrigation — 1990-91

increase is not significant both at 1 per cent and 5 per cent levels of significance.

Table - 3

Growth Rates of gross Irrigated area and levels of significance

Name of the region	Growth rate (in per cent)	t-value	r^2 value
Coastal Andhra	0.95	8.677	0.728
Rayalaseema	0.23	10143	0.044
Telangana	2.07	6.616	0.609
Andhra Pradesh	1.17	7.819	0.685

The growth rates indicated that the rate of increase of irrigated area is 1.17 per cent per annum in the State. The high growth rate of increase is found in Telangana (2.07%) while it is very low in Roayaseema (0.23%).

CONCLUSION

From the above study, it is found that dominant canal (C_4), well (W_4); and tank irrigations (T_4) per-dominant canal (C_3) and well (W_3) irrigation; pre-dominant canl irrigation with accompanying well irrigation (C_3+W_1); pre-dominant well irrigation with accompanying tank irrigation (W_3+T_1); pre-dominant tank irrigation with acompanying well irrigation (T_3+W1) and semi-dominant both well and tank irrigation (W_2+T_2 and T_2+W_2) are the most important irrigation orientated combinations overwhelmingly dominating the irrigation scenario of Andhra Pradesh. It indicates that the devlopment of canal irrigation is highly localised with dominant and predominant orientation confined 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 and inevitable in most of the dry areas of Platau region and in the uplands of the Costal plain. In view of the favourable physical conditions, the tank irrigation is more widespread in different parts of Plateau region. But what is more required for stable and prosperous agriculture in the State is to harness effictively the surface flow of the medium and minor river basins particularly in Rayalaseema and Telangana regions and extend the development of canal irrigation into further.

It is perplexing to state that a considerable regional disparity in the intensity of irrigation is found in the State. There are still areas in the plateau region where scarcity of agricultural water jeopardizes the agricultural economy.

Till now whatever the developments made in irrigation sector were by and large confined to the deltas and the major river basins. In this connection it is worthwhile to mention that there are a number of minor river basins in different parts of the State especially in the plateau region. The present utmost concern should be to tap all the minor river basins of the upland areas effectively rather than going for major irrigation projects concentrating and benefitting a few locations. If the total surface and subsurface water is fully tapped, the present status of irrigation can be raised into two-folds. Undoubtedly, it is the prime need to pay more attention on the water management and irrigation development in the scantily irrigated areas of Andhra Pradesh State.

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