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# **Public Expenditure on Irrigation and Its Impact on Agriculture Production: Evidence from an Indian State**

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## **Abstract**

*Inadequate supply of water for irrigation has been the severe problem for the most of the farmers in the state of Andhra Pradesh in India. There are only very few districts where level of irrigation is reasonably sufficient. In most parts of the state, supply of water for crop cultivation has become a constant concern as the canal irrigation is unequally distributed across the state. As a result of failure of monsoon every year in one part or some parts of the state, farming becomes difficult due to regular crop losses. These conditions have created crisis in agricultural sector and as a result farmers has resorted to suicide. Creation of irrigation infrastructure has been the central in strategies for agricultural development for the State and Central Governments for the past five decades. The irrigation expenditure has been the largest expenditure (both plan and non-plan expenditure) item in the budgets over the years. In this context, the present study investigated the public expenditure on irrigation and its impact on Agriculture production in Andhra Pradesh, India.*

*The study has found that there is a significant positive relation between public expenditure and irrigation development over the period of time in Andhra Pradesh and the consequent increase in gross area cultivated. Cropping pattern in the state has changed due to expansion in irrigation facility. Particularly the area under rice cultivation has been increased after expansion in irrigation development. Increased gross area irrigation has led to multiple cropping expansions in Andhra Pradesh. However, the irrigation sector is characterized by several disquieting features: falling public investment, low canal water use efficiency (25–40 percent as comparable to an achievable level of 65 percent), poor maintenance of distributaries and watercourses due to low recovery from beneficiaries, and poor governance of the irrigation system. To sum up, irrigation infrastructure, major, medium and minor irrigation systems should be strengthened to enhance the agricultural production.*

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## **1 Theoretical framework**

As a largely rural society, most people in India still depend upon agriculture as their major livelihood strategy. The success of any agriculture is influenced by the availability of proper irrigational facilities. Andhra Pradesh is one of the south Indian States with about 85% of area underlain by granitic hardrock aquifers<sup>3</sup>. The annual normal rainfall in the State is 940 mm, which is the primary source of recharge to groundwater. Groundwater yields from the hardrock aquifers are comparatively less (ranging from 50 to 200 litres per minute) against that of 200 to 500 litres per minute in alluvial formations of Gangetic basin in north India. Groundwater is the source of irrigation for about 50% of the gross irrigated area in the State and source of drinking water for 80% of villages (Mohan 2012). The role of agricultural sector in Andhra Pradesh (AP) economy is very significant. Andhra Pradesh is historically called the “Rice Bowl of India” as more than 77% of its crop is rice<sup>4</sup>. Increase in Agriculture production and productivity depends to a large extent, on the availability of water. Productivity on irrigated land is considerable more than the productivity on un-irrigated land. For instance, Rao (2002) has argued that in the late 1980’s per hectare yield of food grains on irrigated land were two to six times higher than the yields on un-irrigated land. The importance of irrigation for agricultural development has been well-recognized. The role of irrigation in drought proofing cover against fluctuating pattern of rainfall and its adverse effects on agricultural production have been well appreciated. Creation of irrigation infrastructure has been the central in strategies for agricultural development for the State and Central Governments for the past five decades. Though irrigation expansion has been chosen as the prime engine in the strategy of agricultural development and poverty alleviation, irrigation requirements are growing with growing population.

These strategies have failed to meet the growing demand for irrigation, in-spite of huge expenditure made in this sector. The irrigation expenditure has been the largest expenditure (both plan and non-plan expenditure) item in the budgets over the years. For the past 50 years, state has spent on an average more than 20 percent of the total plan expenditure on irrigation sector besides large amounts of non-plan expenditure. In recent years the average share of plan

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<sup>3</sup> An underground layer or formation of permeable rocks, sediment, or soil that yields water.

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expenditure on irrigation in the total plan expenditure is about 35 percent. However, this huge expenditure under various five year plans does seem to be effective in terms of their economic return and spread of irrigation.

The above brief theoretical framework highlights the importance of irrigation in an agrarian economy in Andhra Pradesh. The rest of the paper is arranged as follows: Section 2 describes the nature of the data and methodology of the study. Section 3 presents public expenditure on Irrigation in Andhra Pradesh. Section 4 shows trends in irrigation development. Section 5 presents the Impact of irrigation on agricultural development. Section 6 Empirical results and analysis. Section 7 concludes with summary of the findings.

## **2 Data and Methodology**

The present study is based on secondary data, collected from the project reports of the irrigation schemes and Development Reports of the Andhra Pradesh, Publication of the state planning Board, statistical hand book of Andhra Pradesh, Directorate of Economics and Statistics, Agricultural Department and Department of irrigation Development. We have employed linear regression method. This study has used variables like, Public expenditure on irrigation, Gross area irrigated, rain fall, production of rice and productivity of rice from 1979-80 to 2008-09.

## **3. Public Expenditure on Irrigation in Indian state Andhra Pradesh**

In the year 1990, expenditure for irrigation development was 24 percent (Rs.36176 lakh) of the total budget outlay. Gradually it declined to 17.8 percent of the budget outlay in 2002. It means government of Andhra Pradesh neglected the irrigation development in the state. The gross area under irrigation declined from 57.82 lakh hectares in 1996 to 45.36 lakh hectares in 2002, and accordingly area under principal crops and production of principal crops has declined. It led to crisis in agricultural sector of Andhra Pradesh. Farmer's suicide increased because of crop failure without irrigation. So taking the gravity of the situation into consideration the government of Andhra Pradesh launched the Jalayagnam programme in 2004 to give a timely support to agricultural sector of the state.

One of the major causes for this state of conditions is the low performance of irrigation sector. The most important reasons for the low efficiency of this sector that are reported are: (1) High cost of major and medium projects due to their faulty location and designs, (2) escalation of cost of projects due to the delay in completion of projects, (3) neglect of minor and traditional systems and over emphasis on major irrigation, and (4) neglect of maintenance of existing systems and high priority to the construction of new projects.

**Table: 1 Public Expenditure (Plan) on Irrigation in Andhra Pradesh**

<b>Year</b>	<b>Expenditure on Irrigation Rs in Lakhs</b>	<b>Percentage of Expenditure on Irrigation To Development Expenditure</b>
<b>1990-95</b>	average	26
<b>1995-2000</b>	average	22
<b>2000-05</b>	average	19.8
<b>2005-08</b>	average	44.24
<b>1990-91</b>	36176	24
<b>1996-97</b>	68951	22.5
<b>2002-03</b>	148700	17.8
<b>2004-05</b>	344409	30
<b>2005-06</b>	667205	49.6
<b>2006-07</b>	912608	50.1
<b>2007-08</b>	1221596	45
<b>2008-09</b>	1001804	32.2

*Source: AP abstracts, 1989-2009*

Under Jalayagnam programme government of Andhra Pradesh has extended more money for irrigation development. In the budget, about 50 percent of total outlay was allocated for irrigation development. After 2004 government spending on irrigation development has rapidly increased. In the year 2006 expenditure on irrigation was Rs. 9, 12,608(50 percent) lakhs, against Rs.148700 (17.8 percent) in 2002. But in 2007 to 2008 allocation for irrigation development decreased compared to the year 2006. And this massive expenditure on irrigation development in the state has made agricultural sector a success in the state.

Government with its commitment allocated Rs 6,500 crores during 2005-06 to irrigation under State plan which accounts for 49 percent of the total plan size of the state, and 49.3 percent was allocated during 2006-07. But it declined to 31.5 percent during 2008-09. Irrigation infrastructure is the permanent and trunk to spur the development of the state. The participation in the construction of irrigation projects really make a difference for the infrastructure building and

scope for the establishment of allied/ancillary industries, leading to major contribution to the socio economic development of the state. Some of the projects started under Jala Yagnam program were in different stages of construction. Some projects have been completed almost 75 percent along with 20 incomplete projects, if total 39 projects were completed irrigation facility will be available to ayacut. To complete important projects it requires Rs.8777.15 crores. If these important projects are completed 20, 63,888 acres new ayacut will be provided with irrigation and 14, 50,977 Acres ayacut will be stabilized.

In spite of the huge expenditure made in this sector, it has failed to provide cover against fluctuation pattern of rainfall. The problem has been aggravated by the spate of droughts for the past ten years as the rainfall has been substantially less than normal over most of the period. The series of continuous droughts have affected surface and groundwater sources. Its impact can be seen in the prevailing agrarian conditions in the Andhra Pradesh for the past few years. So the government of Andhra Pradesh launched massive irrigation development program *jalayagnam in* 2004. Given the magnitude of the expenditure in irrigation sector and its role in agricultural development, it is necessary to examine the implications of this expenditure on irrigation sector in terms of its sustainability, spread of irrigation, its effectiveness and more importantly the rational of its focus on major and medium projects. In order to understand the implications of this programme it is necessary to examine the trends in irrigation and problems of irrigation sector in the state.

#### **4 Trends in irrigation development in Andhra Pradesh**

The growth of irrigation in Andhra Pradesh can be studied by certain broad indicators. To begin with, here we have examined the behavior of Gross Irrigated Area (GAI), Net Irrigated Area (NIA) and Area Irrigated More Than Once (AIMO) on the one hand, the behavior of Gross Command Area (GCA), Net Sown Area (NSA) and Area Sown More Than Once (ASMO) on the other.

**Table: 2 Indicators of Irrigation Development (In lakh hectares)**

Year	1990	1996	2002	2004	2006	2008
GCA	131.93	134.1	127.56	125.18	128.11	138.3
GAI	53.7	57.82	55.49	49.87	60.69	67.41
<b>% of GAI in GCA</b>	<b>40.7</b>	<b>43.11</b>	<b>43.5</b>	<b>39.83</b>	<b>47.37</b>	<b>48.74</b>
NSA	110.22	108.34	104.1	103.27	101.47	108
NIA	43.05	43.95	42.38	38.81	44.52	48.21
<b>% of NIA in NSA</b>	<b>39</b>	<b>40.56</b>	<b>40.71</b>	<b>37.58</b>	<b>43.87</b>	<b>44.63</b>
ASMO	21.71	25.76	23.46	21.91	26.64	29.62
AIMO	10.65	13.87	13.11	11.06	16.17	19.2
<b>% of AIMO in ASMO</b>	<b>49</b>	<b>53.84</b>	<b>55.88</b>	<b>50.47</b>	<b>60.69</b>	<b>64.82</b>

*Source: An outline of Agricultural situation in Andhra Pradesh 2008-09, AP des*

Analyzing the data in above table we find that Gross area sown in Andhra Pradesh has increased to 138.3 lakh hectares in 2008 against 131.93 lakh hectares in 1990. But gross area has sown between 1990 and 2004 decreased to 131.93 lakh hectares to 125.18. After 2004 gross area sown increased from 125.18 lakh hectares in 2004 to 125.18 lakh hectares in 2008. The percentage of gross area irrigated in gross area sown explains that gross area irrigated has increased to 40.7 percent in 1990 to 48.74 in 2008. Gross area irrigated has decreased from 40.7 percent in 1990 to 39.83 percent in 2004. After 2004 gross area irrigated has been increased from 39.83 percent in 2004 to 48.74 percent in 2008.

Net area sown has decreased from 110.22 lakh hectares in 1990 to 108 in 2008, but during the same time net irrigated area has increased from 43.08 lakh hectares in 1990 to 48 lakh hectares in 2008. Percentage of net area irrigated has also increased from 37.58 to 44.63 lakh hectares in between 2004 and 2008. The area sown more than once (ASMO) increased from 21.71 lakh hectares in 1990 to 29.62 lakh hectares in 2008. Particularly after 2004 ASMO rapidly increased from 21.91 lakh hectares in 2004 to 29.62 lakh hectares in 2008. The Percentage of AIMO in ASMO shows that AIMO has increased to 64.82 percent in 2008 against 49 percent in 1990. This total analysis explains that the area under GAS, GAI, NAS, NIA, ASMO and AIMO have rapidly increased after 2004. And this improvement in irrigation has shown its result in rapid agricultural development in the state. This also explain the impact of irrigation development under Jalayagnam program

#### 4.1 Area Irrigated by Various Sources in Andhra Pradesh

In Andhra Pradesh various sources of irrigation played a significant role for the development of agriculture and other fields of development. The following table explains the area irrigation under various sources in Andhra Pradesh. Data show that in the state, there has been a significant decline in irrigation through tanks. But this decline was compensated by significant improvement in well irrigation in the state.

As presented in table-3 the gross area irrigated by all sources during the year 2008-09 is 67.41 lakh hectares. This accounted for 48.7 percent of the gross cropped area as against 39.83 percent during 2004-05.

**Table:3 Area Irrigated by Various Sources in Andhra Pradesh (In lakh hectores)**

Year	1996	2002	2004	2006	2008
Canals	21.99 (38.03)	14.52 (32.01)	17.3 (34.69)	22.98 (37.86)	23.76 (35.24)
Tanks	9.69 (16.75)	4.54 (10)	5.15 (10.32)	6.96 (11.46)	7.26 (10.76)
Tube Wells	10.76 (18.6)	16.01 (35.29)	17.5 (35.09)	20.2 (33.28)	23.65 (35.08)
Other Wells	13.15 (22.74)	8.78 (19.35)	8.13 (16.3)	8.71 (14.35)	10.52 (15.6)
Other Sources	2.23 (3.8)	1.51 (3.32)	1.79 (3.58)	1.84 (3.03)	2.22 (3.29)
Gross Area Irrigated	57.82	45.36	49.87	60.69	67.41

*Source: An outline of Agricultural situation in Andhra Pradesh 2008-09, AP des. (Parentheses figures indicates Percentage of Area Irrigated by Various Sources in gross area irrigated)*

##### a) Canal irrigation

The share of canal irrigation was 38 percent of the total in 1996. It came down to 32 percent in 2002. But after Jalayagnam programme has been initiated the government of Andhra Pradesh extended more money for irrigation development, under this programme government of Andhra Pradesh completed 12 major and medium irrigation projects. As a result area under canal irrigation has increased to 35 percent of the total in 2008 against 32 percent in 2002.



**b) Tank irrigation:**

In Andhra Pradesh tank irrigation gradually declined in between 1996 and 2002. In the year 1996 area irrigated under tank irrigation was 23 percent of the total but it declined to 10 percent in 2002. The government of Andhra Pradesh increased the expenditure on minor irrigation projects in the year 2000 through Jalayagnam and different Water shed Programmes. As a result area under Tank irrigation cultivation increased to 16 percent (7.26 lakh) against 10 percent (4.54 lakh hectares) in 2002.

**c) Tube well irrigation**

Area under tube well irrigation has shown rapid increase over the years in Andhra Pradesh. Because private expenditure on tube well irrigation has increased. In between 1996 and 2008 area under tube well irrigation has increased significantly from 18 percent (10.76 lakh hectares) to 35 percent (23.65 lakh hectares) of the total irrigation. So there has been a rapid growth of irrigation through tube wells compared to other means of irrigation in the state.

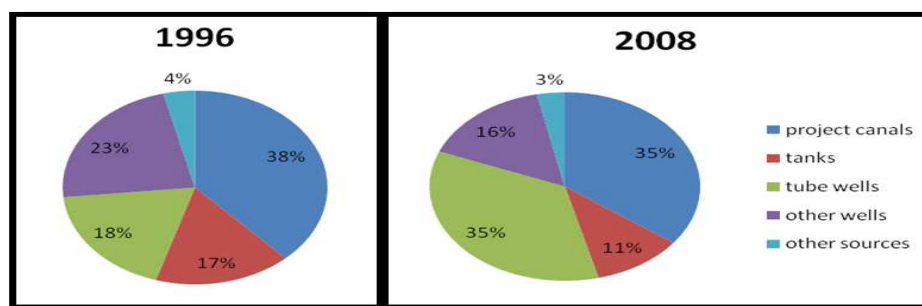
**d) Other wells**

Area under other wells irrigation has increased from 17 percent in the year 1996 to 19 percent in 2002. But table-3 shows that in between 2002 and 2008 area under other wells irrigation has declined from 19 percent to 11 percent.

**e) Other Sources**

Area under other sources of irrigation has slowly declined in between 1996 and 2008. The area irrigated under other sources was 4 percent of the total in 1996, but in 2008 it declined to 3 percent.

**Figure: 1 Percentage of Area Irrigated by Various Sources**



Source: An outline of Agricultural situation in Andhra Pradesh 2008-09, AP des

Overall gross area irrigated has increased from 57.82 lakh hectares in 1996 to 67.41 lakh hectares in 2008. But in between 1996 and 2002 gross area irrigated has declined from 57.82 lakh hectares to 45.36 lakh hectares. So after Jalayagnam programme government of Andhra Pradesh has taken positive steps for irrigation development. It has resulted in an increase in gross area irrigated to 67.41 lakh hectares in 2008 against 45.36 lakh hectares in 2002. It is because of the irrigation development projects undertaken by the Government of Andhra Pradesh there has been an absolute increase in area under irrigation of all sources except irrigation through other wells. Especially, areas under canal and tank irrigation have increased significantly over the last five years.

### **5 Impact of irrigation on agricultural development**

Proper development of irrigation facilities can help solving the problems created by insufficient, uncertain and irregular rains. Production and productivity in agriculture can be increased considerably by extending irrigation facilities. Provision of irrigation facilities can make possible the growing of two or three crops in a year (multiple cropping), and also can introduce the new technology (HYV), and bringing more land under cultivation. Increased irrigation facilities can reduce instability in agricultural output level.

**Table: 4 Share of irrigated area in gross area sown (In lakh hectares)**

<b>Year</b>	<b>1996</b>	<b>2002</b>	<b>2004</b>	<b>2006</b>	<b>2008</b>
Total Food and non Food Crops	57.81	45.36	49.87	60.69	67.41
Total Gross Area Sown(gas)	134.1	115.59	125.18	128.11	138.3
<b>% of Total Irrigated Area to GAS</b>	<b>43.11</b>	<b>39.24</b>	<b>39.84</b>	<b>47.37</b>	<b>48.74</b>

*Source: An outline of Agricultural situation in Andhra Pradesh 2008-09, AP des.*

In the last decade of twentieth century government of Andhra Pradesh neglected irrigation development and allocated low level of amount for irrigation development. And in the same period there was frequent failure of monsoon. It resulted in a significant decline in agricultural production and productivity in the state. After 2004 under the Jalayagnam programme when government of Andhra Pradesh increased its expenditure on irrigation development total area under irrigation increased to 48.74 percent in 2008 against 39.24 in 2004. This progress in GAI has led agriculture development in Andhra Pradesh. The table above explains the improvement in irrigated area in Andhra Pradesh.

## 5.1 Productivity of Principal Crops

Production of principal crops depends on productivity of that particular crop, but productivity of crops depends on various factors like high yield varieties (HYV) seeds, irrigation, use of pesticides and fertilizer etc. Though all the components are complimentary to each other, irrigation plays a major role in the production and productivity of agricultural output. Without irrigation- HYV seeds, fertilizer and pesticides will not have their maximum impact on productivity of land. Productivity of irrigated land is considerably more than the productivity of un-irrigated land. C.H.Hanumantha Rao has argued that in India, in the late 1980s, the per hectare yield of food grain on irrigated land was two to six times higher than the yields of un-irrigated land. After 2004 irrigation facilities has been increased in Andhra Pradesh. Because of this, production and productivity has also increased significantly.

**Table: 5 Productivity of Principal Crops (Kgs per hectare)**

Year	1996-97	2002-03	2004-05	2006-07	2008-09
Rice	2654	2597	3111	2981	3246
Maize	3299	2827	3142	3391	4874
Sugar Cane	75459	66190	75114	82062	78434
Ground Nut	930	559	891	557	551
Cotton	315	229	316	381	434
Chillies	2143	1831	3164	3579	3803

*Source: An outline of Agricultural situation in Andhra Pradesh 2008-09, AP des.*

The above table 5 shows the data on productivity of major crops in the state over time. Productivity of rice has decreased from 2654 kg per hectare in 1996-97 to 2597 kg per hectare in 2002-03. After 2002 productivity of rice has been rapidly increased and reached to 3242 kg per hectare in 2008. Maize productivity decreased from 3299 kg per hectare in 1990 to 2827 kg per hectare in 2002, but improvement in productivity of maize is high after 2002 which reached to 4874 kg per hectare in 2008.

Like rice and maize Productivity of ground nut had also declined from 930 kg per hectare in 1996 to 559 kg per hectare in 2002-3, in 2004-05 there was a sharp rise in the productivity to 891 kg per hectare. But there has been a gradual decline and it reached to 551 kg per hectare in 2008-9. It is because of cultivation area under groundnut is more in Rayalaseema area compared to other regions of Andhra Pradesh. But cultivation in Rayalaseema completely depends on rain fall, which was a frequent failure in 1990s. Ground water level in the area has also come down in the

area year by year. That is why production and productivity of groundnut has declined sharply in Andhra Pradesh.

Productivity of sugar cane improved very less, from 75459 kg per hecter in 1990 to 66190 kg per in hecter in 2002. After 2002 there has been an improvement in productivity of sugarcane i.e. 78434 kg per hecter in 2008 against 66190 kg per hecter in 2002. In the state productivity of cotton has declined from 315 kg per hecter in 1996 to 229 in 2002. But it has increased to 434 kg per hecter 2008 against 229 kg per hecter in 2002. Productivity of chilli declined from 2143 kg per hecter in 1996 to 1831 kg per hecter in 2002. But after 2002 productivity of chilli has increased to 3803 kg per hecter in 2008 against 1831 kg per hecter in 2002.

From the above analysis it is found that the productivity of major crops has increased only after 2002. Because of the government took adequate steps to increase the irrigation level in the state.

## 5.2 Production of Principal Crops

Irrigation is necessary for the maximum production of most farm crops. But in Andhra Pradesh in 1990s irrigation development was stagnant and as a result there was no improvement in agriculture production. After 2004 the government initiated some steps to improve the agricultural production and it has shown a significant result on the production. The table below shows the data on it.

**Table: 6 Production of Principal Crops (In lakh tones)**

<b>Year</b>	<b>1990-91</b>	<b>1996-97</b>	<b>2002-03</b>	<b>2004-05</b>	<b>2006-07</b>	<b>2008-09</b>
<b>Rice</b>	96.54	106.86	73.27	96.01	118.72	142.41
<b>Maize</b>	6.45	11.9	14.86	20.64	24.62	41.52
<b>Pulses</b>	6.95	8.47	10.63	10.17	13.47	14.48
<b>Sugar Cane</b>	126.68	150.3	153.87	157.39	216.92	153.8
<b>Ground Nut</b>	22.67	20.45	8.2	16.39	7.43	9.73
<b>Cotton</b>	11.1	18.78	10.86	21.9	21.82	35.69
<b>Chillies</b>	3.47	5.62	4.09	7.48	7.66	7.73

*Source: An outline of Agricultural situation in Andhra Pradesh 2008-09, AP des.*

The above table gives details about the production of major crops over last fifteen years in the state. If we analyse the data, Production of rice had increased from 96.54 lakh tones in 1990-91

to 106.86 lakh tones in 1996-97. But again it declined to 96 lakh tones in 2004-05. But as we discussed because of irrigation development projects undertaken by the government, the production has increased significantly to 142.41 lakh tones in 2008-09. In case of maize there has been a continuous increase in the production level. The production was 6.45 lakh tones in 1990-91 and by 2008-09 there has been a seven fold increase of the production level, to 41.52 lakh tones in 2008-09.

Sugar cane production was 126.68 lakh tones in 1990-91, it increased to 153.87 lakh in 1990-91, it increased to 153.08 lakh tones in 2002-03, and the production level is stagnant for last eight years. Except 2006-07 when production of sugarcane reached the level of 216.92 lakh tones. In the case of groundnut, the production has suffered a lot. The level of production was 22.67 lakh tones in 1990-91; it decreased to 8.2 lakh tones in 2002-03, then increased sharply to 16.3 lakh tonnes in 2004-05 and declined gradually to 9.73 lakh tones in 2008-09. But cotton production has shown significant increase over the years. In 1990 the production level was 11 lakh tones and reached to 35.09 lakh tones in 2008-09. In between the time chilli production has been doubled, that is, 3.47 lakh tones in 1990-91 to 7.73 lakh tones in 2008-09.

The analysis of the above data shows that the production of major principal crops in the state has increased after 2004. So there has been a positive correlation between Jalyagnam projects and production of major crops.

### 5.3 Impact of irrigation on cropping pattern:

Cropping pattern means the proportion area under different crops during an agricultural year.

**Table-7 Percentage of Irrigated Area in Gross area irrigated (Gai)**

year	1996	2002	2004	2006	2008
% of Rice in Gai	67.93	59.28	58.91	63.2	63.03
Maize	2.09	3.9	4.25	4.56	6.24
Pulses	0.2	0.74	0.52	0.42	0.4
Sugar Cane	5.69	8.13	7.07	7.21	4.71
Ground Nut	6.58	4.913	5.13	4.08	4.36
Cotton	3.07	3.57	4.25	3.41	3.78

Source: An outline of Agricultural situation in Andhra Pradesh 2008-09, AP des

The table 7 shows that after the allocation of land to rice, sugarcane, and groundnut have been declined from the 1990 level. And the area of land to maize, cotton and pulses has increased from 1990 level.

**Table: 8 Progress in Irrigated Area under Food and Non Food Crops (In lakh hectores)**

year	1996	2002	2004	2006	2008
<b>Total Food crops</b>	49.7	38.96	42.27	52.98	58.24
<b>% in GAI</b>	85.9	85.8	84.7	87.2	86.3
<b>Total non Food crops</b>	8.11	6.4	7.6	7.71	9.17
<b>% in GAI</b>	14	14.1	15.2	12.7	13.6

Source: An outline of Agricultural situation in Andhra Pradesh 2008-09, AP des

The table 8 shows that the area under food grain production has increased in Andhra Pradesh over years but the increase is very meager amount. The area under food crops was 85.9 percent of the total in 1996 and increased to 86.3 percent in 2008-09. It is because of the increased need of food grains a proportion of land from non-food crops land area has been diverted in to food crops production.

#### 5.4 Changes in area under cultivation

In general Irrigation development leads to agriculture development. In Andhra Pradesh after 2004 there has been continuous irrigation development which resulted in increase in gross area irrigated, and increase in agricultural production and productivity. During the same period there has been a significant change in area under cultivation.

**Table-9 AREA OF PRINCIPAL CROPS (In lakh hectores)**

Year	1990-91	1996-97	2002-03	2004-05	2006-07	2008-09
<b>Rice</b>	40.36 (36.61)	41.09 (37.9)	28.22 (29.3)	30.86 (29.8)	39.78 (39.2)	43.87 (40.3)
<b>Maize</b>	3.09 (2.8)	3.61 (3.3)	5.26 (5.4)	6.57 (6.3)	7.25 (7.1)	8.52 (7.8)
<b>Pulses</b>	16.32 (14.8)	16.39 (15.1)	21 (21.8)	18.03 (17.4)	19.84 (19.5)	17.71 (16.2)
<b>Sugar Cane</b>	1.82 (1.6)	1.99 (1.8)	2.34 (2.4)	2.1 (2)	2.64 (2.6)	1.96 (1.8)
<b>Ground Nut</b>	23.94 (21.7)	21.98 (20.2)	14.7 (15.2)	18.41 (17.8)	13.34 (13.1)	17.66 (16.2)

<b>Cotton</b>	6.55 (5.9)	10.15 (9.3)	8.03 (8.3)	11.78 (11.4)	9.72 (9.5)	13.99 (12.8)
<b>Chillies</b>	2.08 (1.8)	2.62 (2.4)	2.23 (2.3)	2.37 (2.2)	2.14 (2.1)	2.03 (1.8)

Source: An outline of Agricultural situation in Andhra Pradesh 2008-09, AP des. Parentheses figures indicate percentage of crop area in net area.

Andhra Pradesh is the rice bowl of India. In Andhra Pradesh more area is devoted for rice cultivation compared to all other principal crops. Because coastal area of Andhra Pradesh is convenient for rice production. In 1990 area under rice cultivation was 36.61 percent of the total cultivated area, but it decreased to 29.32 percent in 2002. After 2002 area under rice cultivation has been increased to 40.3 percent in 2008 as against 29.3percent in 2002. During the same time period percentage of area under cultivation of maize has increased from 2.8 in 1990 to 7.8 in 2008. In Andhra Pradesh the share of area under pulses cultivation was 14.8 percent in 1990, it increased to 21.5 percent in 2002, but by 2008 it declined to 16.2 percent. It means that during time farmers in the state given more priority to rice. Area under sugarcane cultivation increased to 2.6 percent in 2006 against 1.6 percent in 1990. Due to irregularities in rainfall, area under cultivation of groundnut decreased from 21.7 percent in 1990 to 15.2 percent in 2002. But in between 2004-08 area under Ground nut cultivation has increased. Area under cotton cultivation has increased from 5.9 percent in 1990 to 8.3 percent in 2002 and jumped to 12.8 percent in 2008.

## 6 Empirical Analyses

To examine the impact of public expenditure on irrigation development, the following regression model was employed:

$$Y = \alpha + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \varepsilon_t$$

Where

Y gross area irrigated (dependent variable),

$\alpha$  is intercept,

$\beta_1, \beta_2$  are coefficients,

Ln  $x_1$  stands natural log of public expenditure on irrigation,

Ln  $x_2$  denotes natural log of annual Rain fall,

$\varepsilon_t$  ; Error term.

**Table: 10 The Impact of Public Expenditure on Irrigation**

<b>Variables</b>	<b>Coefficient</b>	<b>t-Statistic</b>
Constant	-82.02181* (25.00406)	-3.280339
Log EXI	4.052392* (1.050951)	3.855930
Log RAI	13.06603* (2.950344)	4.428648
<b>Dependent variables      GAI</b>		
R <sup>2</sup> - 0.79; Adjusted R-squared - 0.76; Log likelihood -72.81; Durbin-Watson stat - 1.63.		

The impact of public expenditure on gross area irrigated was investigated by using Ordinary Least Squares Methods. The estimated co-efficient, standard deviation, t-ratio is presented in above table. The table show that, the value of R<sup>2</sup>, the coefficient of determination is 0.79 which implies that 79 percent of variation is gross area irrigated is explained by public expenditure on irrigation and rain fall. It shows the goodness of fit and equation.

The coefficient of irrigation expenditure is positive and significant at 1 percent of level of probability. The coefficient value of 4.0523 implies that 1 percent increase in public expenditure an irrigation increases gross area irrigated by 4.052 percent. This is the expected result because increases in expenditure results in improvement of irrigation structures and facilities which enables farmers to bring more area under cultivation, including areas which remained un-irrigated hitherto. The coefficient of rainfall is also positive and significant which indicates the predominate influence of irrigation on the net area sown and the consequent increase in agricultural activities. The coefficient value of 13.066 indicates that 1 percent increases in rainfall brings 13.066 percent increase area irrigated.

### **7. Conclusion:**

Irrigation is the important input for agricultural growth and having positive relation with the yield per hectare. In view of shrinking of tanks and canal irrigation sources, there is need to conserve water and also reasonable and long standing returns to investment and explore the possibility of diverting the canal sources to fill the tanks. The irrigation sector is characterized by several disquieting features: falling public investment, low canal water use efficiency (25–40



percent as comparable to an achievable level of 65 percent), poor maintenance of distributaries and watercourses due to low recovery from beneficiaries, and poor governance of the irrigation system.

Rapid increase in agricultural production being the goal of agricultural development planning in India in general, Andhra Pradesh in particular, there is a sense of urgency with which irrigation potential is being created in the state. This has led to a large scale investment in public surface irrigation development as well as private investment in ground water exploitation, especially during the last couple of decades. The outcome of such endeavor however has not been as expected. Several reasons have been put forward for poor performance of irrigation projects in the state. It can be said that emphasis on irrigation has been and continues to be on construction of new projects rather than efficient management, operation and management of existing systems. Therefore with the same defects most of the irrigation projects in Andhra Pradesh are, merely administered rather than managed. To sum up, irrigation infrastructure, major, medium and minor irrigation systems should be strengthened to enhance the agricultural production.

### **Findings of the study**

- The study has found that there is a significant positive relation between public expenditure and irrigation development over the period of time in Andhra Pradesh and the consequent increase in gross area cultivated.
- The present study found that Groundwater plays a crucial role in irrigation in Andhra Pradesh.
- Production and productivity of crops are positively related to irrigation.
- Cropping pattern in the state has changed due to expansion in irrigation facility. Particularly the area under rice cultivation has been increased after expansion in irrigation development.
- Increased gross area irrigation has led to multiple cropping expansions in Andhra Pradesh.

### **Policy suggestions**

- ❖ Government should take adequate steps for ground water conservation in the state and awareness programmes should be undertaken highlighting its importance.

- ❖ Government started a lot of irrigation projects during the launch of Jalayagnam program. But due to lack of fund some projects have not been completed. So the Government of Andhra Pradesh should allocate more money for irrigation development and should complete the projects under Jalayagnam program.
- ❖ Making full use of biotechnology, taking into account bio-safety concerns, to develop stress-resistant crops that respond better to threats of drought and pests.
- ❖ Promoting water-saving devices such as micro-irrigation, drip irrigation, and sprinkler irrigation systems.

Too much attention of the political-bureaucratic system has been paid to huge investments in interstate river projects, which take too long to complete and involve considerable fund mobilisation – a significant part of which may be subject to diversion and distortion. What is needed is a farmer- centric approach compared to the political-bureaucratic-contractor system that now dominates irrigation policy in the state and – as some would say – ignores the basic needs of the farming community. It would help expedite the process of reform nationally if the Planning Commission and the Command Area Development wings of the central Government of India would make adoption of reform policies and legislation pre-conditions for any assistance from the central government for the irrigation sector. This would help build pressure to expedite the process.

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