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EMERGING MICRO-IRRIGATION TECHNOLOGY FOR SUSTAINABLE FARMING SYSTEMS IN THE DROUGHT PRONE AREAS: A CASE STUDY OF CHITTOOR DISTRICT, ANDHRA PRADESH, INDIA

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Abstract

Chittoor district of Andhra Pradesh has varied Physical and Climatic conditions and the district population is mainly depending on agriculture and its related activities. But, the district is far behind in irrigation sources which is the back bone of agriculture. The district soils and weather phenomenon are very much favorable for agricultural operations. But the district is located in low rain fall receiving and drought prone area and it is vulnerable for discontinues, un reliable, onset failure of monsoons. Once, the district is known for some agriculture surface wells and yearlong water flowing streams. Surface wells are totally replaced by tube wells and water flowing streams became dry and encroached. In later stage majority tube wells of the district became dry even 1400 – 1500 feet wells. In want of irrigation water, several farmers constructed more than one tube well. Some farmers failed in obtaining water even from five to six tube wells constructed which has been leading for 'Farmer Suicides' noticed in several parts of low rainfall receiving areas of Andhra Pradesh state. In this circumstances Andhra Pradesh Micro Irrigation Project (APMIP) was launched in united Andhra Pradesh in the month of November 2003 with an objective of enhancing the crop productivity by improving the water use efficiency through micro irrigation techniques, improving the economic conditions of the farmers by conserving water, bringing additional area into cultivation with the available water resources, enhancing the crop productivity and production, quality, facilitating judicious usage of underground water, saving in power consumption and cost of cultivation. APMIP is being implemented with the assistance from Government of India, State Government and farmer contribution. The APMIP did a sea change in agriculture by bringing major fallow land under cultivation and creating the awareness about various benefits of micro-irrigation techniques in the farming community to achieve the slogan 'more crops per drop'. In this circumstance emergence of micro-irrigation system has very much needed in drought prone area like Chittoor district of Andhra Pradesh with an aim of enhancing the crop productivity by improving the water use efficiency through micro irrigation systems for sustainable agriculture. The present study is based on both empirical observations and secondary information sources to analyze the achievement of micro irrigation in drought prone Chittoor district of Andhra Pradesh.

Introduction

The southern part of Andhra Pradesh which comprises five districts is one of the most climate-vulnerable regions in India. Rainfall is low and unreliable, with frequent droughts. Irrigation is limited - there is a modest surface water source and groundwater resources have been over-exploited with many tube wells drilling regularly failing to strike water and/or tube wells are running dry. The farmers are vulnerable to wells running dry, resulting in considerable distress, and some have committed suicide.

Andhra Pradesh Micro Irrigation Project (APMIP) is a unique and first comprehensive project being implemented in a big way in the state. APMIP was launched in united Andhra Pradesh in the month of November 2003 with an objective of enhancing the crop productivity by improving the water use efficiency through micro irrigation techniques, improving the economic conditions of the farmers by conserving water, bringing additional area into cultivation with the available water resources, enhancing the crop productivity and production, quality, facilitating judicious usage of underground water, saving in power consumption and cost of cultivation. APMIP is being implemented with the assistance from Government of India, State Government and farmer contribution.

In view of the deficit rainfall, rain shadow regions, unpredictable rains and considerable depletion of ground water, the farming community realized the need to adopt the technologies of Micro Irrigation to achieve the concept of “More crop per Drop”. Government of Andhra Pradesh has set a goal to cover the entire potential area available in all the 13 districts of Andhra Pradesh under Micro Irrigation, within the next five years for sustainable agriculture.

The Chittoor district comes under varied agro - climatic and physical conditions. Mainly tanks, canals & tube wells have been utilizing for irrigation in the district. With the existing prolonged dry and drought prone conditions in the district, the cropping pattern has tremendously shifted from principle crops to horticulture crops and leading for remarkable decrease in net area sown. Once the district use to cultivate predominant crops like groundnut, sugar cane, paddy etc, has lost its important in the form of area and number of farmers.

After a grueling field work since 2003, the Andhra Pradesh Micro Irrigation Project (APMIP) has bagged the national records for being number one in involving 1.79 lakh farmers and number three in covering 1.9 lakh hectares under its purview in the drought-prone Chittoor district, latest by 2018-19.

In this circumstance emergence of micro-irrigation system has very much needed in drought prone area like Chittoor district of Andhra Pradesh with an aim of enhancing the crop productivity by improving the water use efficiency through micro irrigation systems for sustainable agriculture. The present study is based on both empirical observations and

secondary information sources.

Objectives

The present study has the following objectives.

1. To find out irrigation water sources and rain fall scenario in the study area.
2. To assess micro irrigation adaptation and as emerging technology.

Data and methodology

The study was designed to assess profile characteristics of emerging micro irrigation technology for sustainable farming systems in drought prone Chittoor district of Andhra Pradesh which was purposively selected. The study area is predominantly depended on monsoon rains and no perennial rivers are found. Hence the farming system is depending on emerging micro irrigation technology. The cropping pattern and its dynamics, irrigation sources and rainfall, emerging of micro irrigation systems, adaptation, impact of micro irrigation and farmer's opinion are taken into consideration for analysis. Both empirical observations and secondary data was collected the office of the Director APMIP. Analysis is made by using simple averages for drawing meaningful interpretations.

Study Area

Chittoor district, the present study area lies in the southern most part of Andhra Pradesh state. It forms a part of the semi-arid as well as backward Rayalaseema region. Geographically, it is located between the 12° 37' and 14° 8' Northern latitudes and between the 78° 33' and 79° 55' Eastern longitudes.

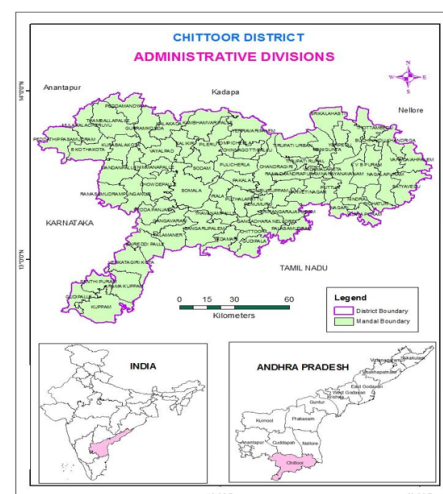


Fig. 1. Study map area

Analysis

In the present study the available region wise irrigation sources were narrated by comparing gross cropped area, dynamics in irrigated land and emerging of micro irrigation technology as sustainable source for agriculture in drought prone Rayalaseema region of Andhra Pradesh state with secondary data sources. A field investigation is also conducted to find out the position of micro irrigation implementation and analyzed field data to find out conclusions.

Chittoor district is basically depends on monsoon rains for its agricultural operations. The district has neither perennial nor major irrigation project. Only a few eastern mandals have irrigation sources under canals which ultimately depend on monsoon rains. Moreover the district lies in drought prone Rayalaseema Region which is identified as one of the drought prone region.

Table 1. Chittoor District – Average Rainfall (In Mms)

S.No.	Year	Rainfall	Above/ Below Normal
	Normal	933.9	
1.	2008-09	876.8	- 6.10
2.	2009-10	758.8	- 18.75
3.	2010-11	1090.5	+16.81
4.	2011-12	934.0	+ 0.01
5.	2012-13	936.1	+ 0.23
6.	2013-14	744.2	- 20.31
7.	2014-15	583.1	- 37.56
8.	2015-16	1176.8	+26.00
9.	2016-17	601.8	- 35.56
10.	2017-18	978.0	+ 4.72

Source: Panning Office, Chittoor

From the above table one can clearly observe that, rainfall from monsoons is very uncertain, uneven, unpredictable and discontinuous. It is very worst condition that district has received less rain fall than normal in five years out of ten years period. This resembles how bad the district continues in doldrums of monsoons. Further it is understood within five negative rainfall years two years namely 2014-15 and 2016-17 have received more than 35 per cent less rain fall which is indication for frequent drought phenomenon in the district.

table 2

In the study area, most of the agricultural operations have been depending on monsoon rains, if monsoon failure is happened and total agriculture would be in mess. The above table clearly indicating that, most of the irrigated cropped area in the district is on Tube well source (81.60%), followed by Tanks (10.59%), Surface wells (7.21%), Canals (0.57%) and other sources (0.3%) respectively. It point out that, the district has neither major rivers nor major irrigation projects and majority of the farmers directly depending on underground water resources through digging of tube wells

by investing huge amount which is not affordable for majority farmers. There are notable incidents causing for farmers suicide wherever tube wells got failure when farmer tried for more than one tube well in continuation of searching for underground water resources. The problem associated with the tube well construction by the farmers is depleting of underground water table and in some areas farmers went up to even 1600 feet depth which also resulted failures. The development and over-exploitation of groundwater resources in certain parts of the district have raised the concern and need for judicious and scientific resource management and conservation of water.

In observation of the existing status of water resources and ever increasing demands of water for meeting the requirements of the speedily growing population, agricultural requirements as well as the problems that are likely to arise in future, a holistic, well intended long-term strategy is needed for sustainable water resource management in drought prone areas. Presently decision support systems are being developed for providing the necessary inputs to the decision makers for water resource judicious utilization.

The Government of Andhra Pradesh considered scientific utilization of the scarce water resources to the growing needs of agricultural sector. As a result, the micro irrigation technology came into existence under the specialized organization known as Andhra Pradesh Micro Irrigation Project (APMIP) which is part and partial of Pradhana Mantri Krishi Sinchayee Yojana (PMKSY) in financial and technology aspects.

Micro irrigation technology has two types of implementation – drip and sprinkler techniques. Both of them save conveyance losses and improve water use efficiency by supplying water near the root zone of the plant to achieve the APMIP target 'more crops per drop'. In recent days even Rain gun technology has been implementing in midway water scarcity areas.

Initially, in the study area, micro irrigation technique use to adopt for plantation crops but currently the technique has been implementing even for principle crops like Paddy and Sugar cane. Moreover, emergence of micro irrigation technology brought a tremendous shift in cropping pattern. Previously the study area was known for principal crops like paddy, sugarcane and groundnut. But, over a period of time cropping pattern shifted to fruits, vegetable and other commercial crops.

Emergence of APMIP and Launching of PMKSY are boon to the agriculture sector in general and to the farmers of drought prone areas in particular. Under the APMIP, farmer is highly encouraged to convert their land under micro irrigation technique by providing high percentage of subsidy for being equipped micro irrigation facility. The following tables present detailed structure of subsidy pattern and financial implication.

Table 2. Chittoor District - Source Wise Irrigated Land (In Hectors)

S.No	Year	Canals	Tanks	Tube Wells	Dug Wells	Other Sources	Gross irrigated Area	Net irrigated Area
1.	2008-09	320	24108	130033	33084	26	187571	147112
2.	2009-10	564	18535	145918	26205	0	191222	147631
3.	2010-11	9359	18126	151757	23855	78	203175	153228
4.	2011-12	5736	17557	147617	21778	109	192797	146197
5.	2012-13	3440	20391	143310	20613	97	187851	144887
6.	2013-14	4866	16011	149363	20253	87	190580	146687
7.	2014-15	2675	12610	136535	17550	81	169451	130316
8.	2015-16	3233	40738	155737	20663	81	220452	175452
9.	2016-17	1056	8437	160585	17933	0	188011	145492
10.	2017-18	1195	22126	170514	15088	58	208981	157026

Source: Panning office, Chittoor

Table 3. APMIP - Subsidy Pattern and Financial Implication - Drip Irrigation

Sl. No	Category of Farmers	GoI assistance (%)	State Share			Total % of Subsidy (3+6)	Farmer Contribution (%)	Ceiling Limit	
			Match-ing Share (%)	Addi-tional Share (%)	Total Share (%) (4+5)			Area in Acres	Sub-sidy in lakhs
1	2	3	4	5	6	7	8	9	10
1	SC/ST (Under SF/MF Category)	33	22	45	67	100	0	5	2.00
2	SF/MF(Other SC/ST)	33	22	35	57	90	10	5	2.00
3	Medium farmers of Coastal Districts (5 to 10 Acres)	27	18	25	43	70	30	10	2.80
4	Medium farmers of Rayalaseema Districts &Prakasam (5 to 10Acres)	27	18	45	63	90	10	10	2.00
5	Others	27	18	5	23	50	50	-	4.00

Source: Compiled from the reports of PD office of the APMIP Chittoor

Table 4. APMIP - Subsidy Pattern and Financial Implication - Sprinkler Irrigation

Sl. No.	Category of Farmers	Assistance GoI (%)	State Share			Total % of Subsidy (3+6)	Farmer Contribution (%)	Ceiling Limit	
			Match-ing Share (%)	Addi-tional Share (%)	Total Share (%) (4+5)			Area in Acres	Subsidy amount in lakhs
1	2	3	4	5	6	7	8	9	10
1	Small and Marginal farmers of all categories	33	17	0	17	50	50	5	
2	Other Farmers	27	18	5	23	50	50	5	

Source: Compiled from the reports of PD office of the APMIP Chittoor



As stated in the above tables, subsidy is ranging from 100 per cent to 50 per cent in drip irrigation and maximum subsidy is being given to SC/ST farmers who come under marginal and small farmers. Government of India under PMKSY is providing subsidy ranging from 33 per cent to for small and marginal farmers to 27 per cent to the rest of farmers. However, the subsidy percent is same (50%) for all the farmers in sprinkler irrigation and no change in the share of government of India assistance.

As per PMKSY guidelines, beneficiaries who have already availed the subsidy for micro irrigation cannot avail further assistance for the same land for next 7 years. The farmers who have availed subsidy for Sprinkler Irrigation are eligible to avail balance eligible subsidy for Drip Irrigation within the ceiling limit i.e., Rs. 2.00 lakhs (-) subsidy already availed by SC and ST farmers under SF/ME, Small and Marginal other than SC/ST and medium farmers of Rayalaseema Districts and Rs.2.80 lakh (-) subsidy already availed by Medium farmers and Rs.4.00 lakhs (-) subsidy already availed by other farmers. The farmer who have availed subsidy for Drip irrigation are eligible to avail balance eligible subsidy for Sprinkler Irrigation in same land within the ceiling limit as stated above as per the field / crop requirement. The farmers who have availed subsidy for sprinkler irrigation are not eligible to avail subsidy again for sprinkler for the same land.

State level APMIP achievement

APMIP has covered an area of 6,43,885.05 hectares of land and 4,69,097 farmers over a period of five years i.e from 2014 – 15 to 2018-19. It is very interesting to note that, in five years of period 122 times growth in farmers and more than 18 times growth in area extension is achieved.

Table 5. Area and farmers covered under Micro Irrigation - Andhra Pradesh

S.No.	Year	No. of Farmers covered	Area Covered in hectares
1.	2014-15	3841	35317.26
2.	2015-16	11532	90726.03
3.	2016-17	121319	135228.53
4.	2017-18	161041	182612.00
5.	2018-19	171364	200001.21
Total		4, 69,097	6,43,885.05

Source: Compiled from the reports of office of the APMIP

Area in hectares, Amount in lakhs

In Chittoor district, remarkable achievement has been recorded in micro irrigation under APMIP under different caste categories. From 2003-04 to 2018-19 with five year interval micro irrigation achievement has been interpreted. In Scheduled Caste (SC) it started with 41 farmers covering 55.88 hectares in 2003-04 and by 2018-19 it has spread to 21,943 farmers and covered 17,617.51 hectares of cropped land. In respect to Scheduled Tribe (ST) farmers micro irrigation was started with only 5 farmers and 6.28 hectares of land was only covered. Over a period of 15 years it rises to 6045 ST farmers and extended to an area of 5008.19 hectares of land. In Backward Class (BC) farmers community micro irrigation was started with 323 farmers and 473.73 hectares of land in 2003-04 and it has raised to 52,700 farmers and 46,838.25 hectares of land. With respect to Other Community (OC) farmers, in 2003-04 micro irrigation was started among 1,396 farmers and in 2,197.07 hectares of land and it outstandingly raised to 95,086 farmers and 1,09,997.68 hectares of land.

In micro irrigation tremendous progress has been achieved both in number of farmers and area covered under in it. It is observed that, 535.20 times farmers and 315.27 times area of land increase has achieved in SC farmers community. Among ST farmers the progress of micro irrigation recorded as 1209 times in number of farmers and 797.48 times in area of land. In BC community farmers 163.16 times in farmers and 98.87 times in area increase is achieved. 68.11 times in farmer and 50.07 times in area respectively is achieved in OC farmers.

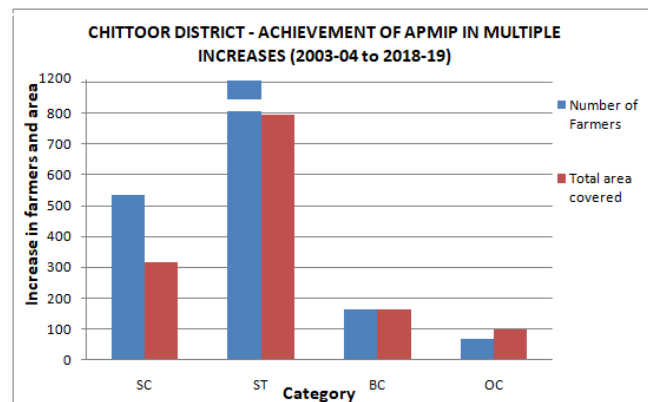


Fig. 2. Chittoor district - achievement of APMIP in multiple increases (2003-04 to 2018-19)

Since inception, the APMIP achieved the targets to a greater extent from 1765 to 175773 farmers, 2732.96 to 179161.70 hectares of land and subsidy support from 185.10 to 100278.94 on the needed micro irrigation equipments as well as power. The impact of micro irrigation technology led to enormous changes in cropping pattern, bringing additional

Table 6. Andhra Pradesh micro irrigation project: Chittoor District Caste wise achievement from 2003-04 to 2018-19

Sl. No.	Year	SC			ST			BC			Others		
		No. of farmers	Area	Subsidy	No. of farmers	Area	Subsidy	No. of farmers	Area	Subsidy	No. of farmers	Area	Subsidy
1.	2003 - 04	41	55.88	3.32	5	6.28	0.29	323	473.73	29.21	1396	2197.07	152.35
2.	2008 - 09	635	447.61	97.53	161	109.53	40.57	1018	1121.19	408.85	6416	9080.08	2490.38
3.	2013 - 14	265	219.83	172.99	71	57.70	37.89	2155	1949.87	1483.37	3367	3400.66	2263.02
4.	2018 - 19	6613	5216.85	3914.64	1704	1500.74	1024.01	9032	7890.14	5901.44	11750	13197.20	8100.17
TOTAL		21943	17617.51	11719.68	6045	5008.19	3207.37	52700	46838.25	31929.25	5086	109997.68	54142.65

Source: Compiled from the reports of PD Office of the APMIP Chittoor (area in hectares, Amount in lakhs)

Table 7. Andhra Pradesh Micro Irrigation Project: Chittoor Total micro irrigation achievement from 2003-04 to 2018-19 (Five year interval)

Sl. No.	Year	No. of farmers	Area	Subsidy
1.	2003 - 04	1765	2732.96	185.10
2.	2008 - 09	8230	10758.40	3037.33
3.	2013 - 14	5858	5628.06	3957.27
4.	2018 - 19	29098	27804.93	18940.26
TOTAL		175773	179461.70	100278.94

Source: Compiled from the reports of PD Office of the APMIP Chittoor (Area in hectares, Amount in lakhs)

Table 8. Chittoor District - Achievement of APMIP In Multiple Increases (2003-04 to 2018-19)

S.No.	Category	Farmers increase	Area achievement
1.	SC	535.20	315
2.	ST	1209	797.48
3.	BC	163.16	163.16
4.	OC	68.11	98.8
5.	Total	99.59	65.67

Source: Compiled from the reports of PD office of the APMIP Chittoor

area under irrigation, and achievement of target 'more crops per drop'.

Conclusions

It is traced that, due to monsoon rain dependency is at maximum level, frequent crop failures and drought phenomenon conditions are common and have lead for tremendous change in cropping pattern and shifting from open irrigation to micro irrigation. For installation of micro irrigation technology government encouragement is also very appreciable and encouraging by providing up to 100% subsidy to farmers based on their social category. Finally, it is concluded that the APMIP is a fortunate thing to improve the economic conditions of the farmers in general and farmers of

drought prone areas like Rayalaseema region in particular in the journey of sustainable agriculture.

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