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An analysis of On-Demand Water Supply System in tank command areas of Karnataka

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Abstract: The highest number of tanks is located in south India. The water losses in these tanks were rerecorded up to 30 per cent which is mainly due to seepage, percolation and evaporation in transit from the storage reservoir to the farmer's field. This has resulted in less area under irrigation and low yield which is mainly due to failure of crops from moisture stress at the later stages. Hence, to minimize the water loss and improve conveyance efficiency, an investigation on the underground buried pipe system and efficient irrigation methods was carried out with the main objectives of introducing buried pipe system in the command area and investigating the effectiveness of on demand water supply system and efficient irrigation on net returns per ha and net revenue. The results indicated that, there was increase in area under irrigation and increased returns from the crops cultivated. About 110.05 to 768.77 per cent increase in net revenue was recorded from 2004-05 to 2007-08 compared to base year 2003-04. About 54.29 to 146.33 per cent increase in area expansion with different crops was recorded over base year. In addition, about 110.05 to 768.77 per cent of net revenue of the command area had been increased compared to the base year.

Key words: On demand water delivery; tank command area; underground buried pipe system; conveyance efficiency; water use efficiency.

1. INTRODUCTION

Irrigation is a key input in crop production. Water for irrigation is scarce and farmers and crops are more dependent on optimum irrigation for sustainable agriculture. To strengthen sustainable agriculture, tank irrigation system was established centuries ago. At present, there are about 36,500 irrigation tanks in Karnataka and these tanks have not been managed properly. As such the command area as well as water-spread area needs improvements for continuous use of tanks to promote irrigated agriculture. It is estimated that about 30 per cent of water stored is wasted in command area in the form of conveyance and application losses during surface irrigation. In the command area, improper management of irrigation water not only leads to wastage of water but also land degradation. Under these conditions, two shortcomings of surface irrigation systems becomes more important, firstly, a high proportion of water is lost between the source and crop, and secondly deliveries of water to individual farmers are not optimum in quality or timing or reliability. The extent of these shortcomings depends on the physical infrastructure and management of the system, and its particular environment. The awareness of various options available to tackle these problems and achieve better performance from surface irrigation systems, include lined canals to reduce losses, control structures and systematic management to improve deliveries and "demand" type systems to enable farmers to control their own water supplies.

A different approach need to be adopted. Alternative technology is the low pressure buried pipe line system for surface irrigation in the tank command area. This offers improvements over conventional surface irrigation system with canals. It will be more efficient and more flexible in operation than conventional canal system, with fewer environmental problems. Further, by adopting advanced irrigation methods, it is possible to restore about 30 per cent of irrigation water which can be used to bring additional area under irrigation. Present day knowledge of soil-moisture-plant relations permits irrigation systems to be designed for applying water in correct quantities when needed. Irrigation water could be applied at rates to suit the infiltration rates of soils and thereby obtain maximum efficiency in water use and prevent deterioration of land quality. In order to use this knowledge effectively, a reasonably accurate measurement of water is necessary. Keeping the above points in view, this Pilot Study was planned in the project area, with the objective of introducing buried pipe system in the command area and investigating the effectiveness of on demand water supply system and efficient irrigation on net returns per ha and net revenue.

2. MATERIAL AND METHODS

The study was conducted from 2003-04 to 2007-08 at Chunchdenahalli tank command area (Venugopal Swamy Doddakere) situated adjacent to Chunchadenahalli village, Kolar district, which is one of the drought affected districts in Karnataka and has more number of irrigation tanks[1]. The location map of the study area is given in fig.-1. The Chunchadenahalli tank has an independent catchment area of 544 ha and water spread area of 12.5 ha. The command area consists of 24.0ha, which is owned by 75 farmers. The total length of the tank bund is 776.84 m. The total volume of water in the tank at full tank level was found to be 158210.848 m^3 whereas, it was 244353.809 m^3 at maximum water level.

In this tank command area, the buried pipe distributory system was designed based on the rate of water discharge in the pipe system for individual plots, crop water demand of the command area and cropping pattern. The designed diameter, of 40 mm, 50 mm, 63 mm, 75 mm and 90 mm pipes with 6Kg/cm2 and 4 Kg/cm2 pressure class of IS-4985 have been used to irrigate the entire command area of 24.0 ha. Solar energy was harnessed through solar pumps to lift water from the jack well.

The crops in the command area are intensified and diversified. The economics of the crops cultivated from 2003-04 to 2007-08 was analysed based on the cost of cultivation, net returns and net revenue. The benefit cost analysis of on-demand water supply system was worked out based on the available market costs by using procedure developed by [2].

3. RESULTS AND DISCUSSION

During kharif 2003 to 2008, there was a significant change in the net returns obtained per hectare for different crops. The paddy, mulberry, tomato and cauliflower occupied major area in the command and recorded higher net returns per ha compared to other crops. There was a drastic change in the net profit incurred per ha by recording Rs. 49,567(paddy), Rs. 54,600(mulberry), RS. 1,54,237 (tomato) and Rs. 1,26,726 (cauliflower) net profits during Kharif 2007-08 compared to base year 2003-04 (Rs. 11,600 and 17,199 for paddy and mulberry respectively) (Table-1).
On demand water supply system has made significant influence in increasing the total net revenue (area multiplied by net returns) of the command area by recording maximum of Rs. 11.22 lakhs during Kharif 2007-08 compared to base year 2003-04 (Rs. 1.08 lakhs) (Table-2). Among different crops, mulberry (Rs. 61003 to 478296) followed by tomato (Rs. 109740 to 262202) and paddy (Rs. 60839 to 99629) were recorded the highest net revenue compared to base year 2003-04.

During rabi/summer 2003 to 2008 (Table-3), the mulberry, tomato, cauliflower and betel vine were the major rabi/summer crops in the command and recorded higher net returns of Rs. 25200 to 53300, Rs. 80000 to 156700, Rs.101221 to 140786 and Rs. 12250 to 21599 respectively as compared to base year (Rs. 18400, 64285, 101250 and 12250, respectively). Similarly, Table-4 indicate the increased total net revenue of the command area from Rs. 1.34 lakhs (base year 2003-04) to Rs. 9.93 lakhs during 2007-08.

The increase in the net returns (Rs./ha) and net revenue (Rs./ha) of the tank command area may be attributed to implementation of on-demand water supply system through advanced efficient irrigation methods, expansion of area due to availability of water for two seasons, introduction of high value crops with low water requirement, introduction of jack well with solar pump, saving in electricity and change in the cropping pattern from single crop to multiple cropping have contributed towards increase in the net returns and revenue of the command area. The current findings were in supportive of Campbell (1984)[3] who reported that economic benefits were generated by the higher level of agricultural development (growing of high-value crops) which was made possible by the improved flow deliveries.

Table-1: Effect of on demand water supply on net returns from different crops during Kharif 2003 to 2008

Crop	Total returns (Rs.)					Cost of cultivation (Rs.)					Net returns (Rs.)				
	2003-04	2004-05	2005-06	2006-07	2007-08	2003-04	2004-05	2005-06	2006-07	2007-08	2003-04	2004-05	2005-06	2006-07	2007-08
Paddy	20,850	22,550	31,216	52,550	65817	9,250	9,500	10,000	13000	16250	11,600	13,050	21216	39550	49567
Ragi (Rainfed)	10,000	9,302	7,699	19,175	21870	2,000	2,150	2,250	4,875	7,500	8000	7152	5449	14300	14370
Ragi (Irrigated)	0	0	0	0	23139	0	0	0	0	8,800	0	0	0	0	14339
Jowar	16,000	0	0	0	0	9000	0	0	0	0	7000	0	0	0	
Mulberry	41,799	45,245	69,700	81,600	81850	24,600	25,400	26800	27000	27250	17199	19845	42900	54600	54600
Tomato	0	0	138,000	211,250	224237	0	0	45000	57500	70,000	0	0	93000	153750	154237
Cauliflower	0	155,500	0	207,250	126726	0	65,500	0	70,000	0	0	90000	0	137250	126726
Capsicum	0	0	42,300	171,750	0	0	0	25,000	30,000	0	0	0	17300	141750	0
Betal vine	16,250	16,250	18,800	26,600	0	4,000	4,000	4,500	5,000	0	12250	12250	14300	21600	0
Cabbage	0	0	157,142	0	0	0	0	40,000	0	0	0	0	117142	0	0
Chillies	0	0	77,040	0	0	0	0	25,000	0	0	0	0	52040	0	0
Coriander	0	0	0	0	357500	0	0	0	0	45,000	0	0	0	0	312500
Red gram (Veg.)	0	0	0	0	163200	0	0	0	0	19,200	0	0	0	0	144000
Field Bean (Veg.)	0	0	0	0	91000	0	0	0	0	35,000	0	0	0	0	56000
Radish	0	0	0	48000	0	0	0	0	9250	0	0	0	0	38750	0
Total	104899	248847	541897	818175	1155339	48850	106550	178550	216625	229000	56049	142297	363347	601550	926339

Table-2: Effect of on demand water supply on net returns from different crops and net revenue during Kharif 2003 to 2008

Crop	Area (ha)					Net returns (Rs./ha)					Net revenue (Rs./ha)				
	2003-04	2004-05	2005-06	2006-07	2007-08	2003-04	2004-05	2005-06	2006-07	2007-08	2003-04	2004-05	2005-06	2006-07	2007-08
Paddy	2.561	4.662	4.416	3.845	2.01	11,600	13,050	21216	39550	49567	29707	60839	93689	152069	99629
Ragi (Rainfed)	2.373	4.98	6.3	2.713	4.54	8000	7152	5449	14300	14370	18984	35616	34328	38795	65239
Ragi (Irrigated)	0	0	0	0	2.31	0	0	0	0	14339	0	0	0	0	33123
Jowar	0.135	0	0	0	0	7000	0	0	0		945	0	0	0	0
Mulberry	3.074	3.074	4.04	8.14	8.76	17199	19845	42900	54600	54600	52869	61003	173316	444444	478296
Tomato	0	0	1.18	1.187	1.7	0	0	93000	153750	154237	0	0	109740	182501	262202
Cauliflower	0	0.513	0	0.1	0.19	0	90000	0	137250	126726	0	46170	0	13725	24077
Capsicum	0	0	0.2	0.27	0	0	0	17300	141750	0	0	0	3460	38272	0
Betal vine	0.5	0.5	0.4	0.232	0	12250	12250	14300	21600	0	6125	6125	5720	5011	0
Cabbage	0	0	0.28	0	0	0	0	117142	0	0	0	0	32799	0	0
Chillies	0	0	0.1	0	0	0	0	52040	0	0	0	0	5204	0	0
Coriander	0	0	0	0	0.24	0	0	0	0	312500	0	0	0	0	75000
Red gram (Veg.)	0	0	0	0	0.2	0	0	0	0	144000	0	0	0	0	28800
Field Bean (Veg.)	0	0	0	0	1	0	0	0	0	56000	0	0	0	0	56000
Radish	0	0	0	0.2	0	0	0	0	38750	0	0	0	0	7750	0
Total	8.643	13.729	16.916	16.687	20.95	56049	142297	363347	601550	926339	108631	209754	458258	882569	1122369

Table-3: Effect of on demand water supply on net returns from different crops during rabi/summer 2003 to 2008

Crop	Total returns(Rs.)					Cost of cultivation(Rs.)					Net returns(Rs.)				
	2003-04	2004-05	2005-06	2006-07	2007-08	2003-04	2004-05	2005-06	2006-07	2007-08	2003-04	2004-05	2005-06	2006-07	2007-08
Paddy	0	0	0	48449	0	0	0	0	15500	0	0	0	0	32949	0
Ragi (Rainfed)	0	0	0	21172	0	0	0	0	6875	0	0	0	0	14297	0
Mulberry	43175	51100	79893	81270	391618	24775	25900	26853	27970	33811	18400	25200	53040	53300	357807
Tomato	105435	123435	167125	200483	227950	41150	43435	52375	65850	71250	64285	80000	114750	134633	156700
Cauliflower	167500	168721	189850	207824	213921	66250	67500	69850	70575	73135	101250	101221	120000	137249	140786
Betal vine	16374	16625	22595	26834	0	4124	4375	4595	5235	0	12250	12250	18000	21599	0
Chillies	0	0	0	286999	0	0	0	0	25250	0	0	0	0	261749	0
Coriander	0	45825	53626	37677	70138	0	39825	41626	22925	45225	0	6000	12000	14752	24913
Raddish	0	0	36600	49000	0	0	0	9100	10250	0	0	0	27500	38750	0
Horsegram	0	7500	0	0	0	0	3000	0	0	0	0	4500	0	0	0
Fodder Maize	0	25250	27200	0	0	0	6000	6200	0	0	0	19250	21000	0	0
Beetroot	0	0	42500	0	0	0	0	12500	0	0	0	0	30000	0	0
Peas	0	0	21220	0	0	0	0	12220	0	0	0	0	9000	0	0
Gherkins	0	0	34400	0	0	0	0	15800	0	0	0	0	18600	0	0
Potato	0	0	0	134000	0	0	0	0	42000	0	0	0	0	92000	0
Brinjal	0	0	0	156002	152747	0	0	0	33250	34000	0	0	0	122752	118747
Total	332484	438456	675009	1249710	1056374	136299	190035	251119	325680	257421	196185	248421	423890	924030	494650

Table-4: Effect of on demand water supply on net returns from different crops and net revenue during Rabi/summer 2003 to 2008

Crop	Area (ha)					Net returns (Rs./ha)					Net revenue (Rs./ha)				
	2003-04	2004-05	2005-06	2006-07	2007-08	2003-04	2004-05	2005-06	2006-07	2007-08	2003-04	2004-05	2005-06	2006-07	2007-08
Paddy	0	0	0	1.179	0	0	0	0	32949	0	0	0	0	38846	0
Ragi (Rainfed)	0	0	0	0.282	0	0	0	0	14297	0	0	0	0	4031	0
Mulberry	4.611	4.611	6.24	12.21	12.402	18400	25200	53040	53300	53504	84842	116197	330969	650793	663556
Tomato	0.147	1.431	1.019	2.354	1.5	64285	80000	114750	134633	156700	9449	114480	116930	316926	235050
Cauliflower	0.28	0.393	2.511	0.589	0.29	101250	101221	120000	137249	140786	28350	39779	301320	80839	40827
Betal vine	1	0.9	0.464	0.464	0	12250	12250	18000	21599	0	12250	11025	8352	10021	0
Chillies	0	0	0	0.558	0	0	0	0	261749	0	0	0	0	146055	0
Coriander	0	0.076	0.277	0.254	0.861	0	6000	12000	14752	24913	0	456	3324	3747	21450
Raddish	0	0	0.394	0.08	0	0	0	27500	38750	0	0	0	10835	3100	0
Horsegram	0	1.806	0	0	0	0	4500	0	0	0	0	8127	0	0	0
Fodder Maize	0	0.608	0.878	0	0	0	19250	21000	0	0	0	11704	18438	0	0
Beetroot	0	0	0.234	0	0	0	0	30000	0	0	0	0	7020	0	0
Peas	0	0	0.13	0	0	0	0	9000	0	0	0	0	1170	0	0
Gherkins	0	0	0.268	0	0	0	0	18600	0	0	0	0	4984	0	0
Potato	0	0	0	0.282	0	0	0	0	92000	0	0	0	0	25944	0
Brinjal	0	0	0	0.234	0.273	0	0	0	122752	118747	0	0	0	28723	32417
Total	6.038	9.825	12.415	18.486	15.326	196185	248421	423890	924030	494650	134892	301769	803343	1309030	993302

The pooled data on the net revenue of both seasons of the year are shown in Table-5. About 110.05 to 768.77 per cent increase in net revenue has been recorded from 2004-05 to 2007-08 compared to base year 2003-04. Similarly, the cumulative effect of on demand water supply system on the expansion of area under irrigation and total revenue of the command for the year has been presented in Table-6. The results revealed that about 54.29 to 146.33 per cent increase in area expansion with different crops has been recorded over base year. In addition, about 110.05 to 768.77 per cent of net revenue of the command area has been increased compared to the base year.

Table-5: Net Revenue from 2003 to 2008 (Kharif- rabi / summer)

Season	2003-04	2004-05	2005-06	2006-07	2007-08
Kharif (Rs.)	108631	209754	458258	882569	1122369
Rabi/Summer (Rs.)	134892	301769	803343	1309030	993302
Total (Rs.)	243523	511523	1261601	2191599	2115671
Increase over base year (%)	Base	110.05	418.06	799.95	768.77

Table-6: Cumulative effect of on demand water delivery technology on increased area under irrigation and net returns during 2003 to 2008

Particulars	2003-04	2004-05	2005-06	2006-07	2007-08
Area Covered (ha.) (Kharif+Rabi/Summer)	14.68 (Base year)	22.65	29.33	35.18	36.21
Per cent increase in area over base year	Base year	54.29	99.79	139.64	146.33
Net revenue from the command (Rs. In lakh)	2.43	5.11	12.61	21.91	21.15
Per cent increase in net revenue over base year	Base year	110.05	418.06	799.95	768.77

4. CONCLUSION

The on demand water delivery system was proved to be an excellent and unique method of water saving technology which improves the conveyance efficiency. Quantum of water saved can be effectively make use to extend the irrigation source of water as protective irrigation to grow low water consumptive and high value crops like vegetables, flowers, mulberry etc. This innovative study will help to replicate in all the tank irrigated situations so that the maximum number of beneficiaries can be covered for protective irrigation during critical periods of the crops growth by minimizing maximum possible loss of water due to effective conveyance methods. This will not only help to increase the water use efficiency of the crops but also the productivity and production per unit area.

REFERENCES

[1] Raju K.V., Kranth G.K., Bhende M.J., Rajasekhar D and Gayathridevi K.G. (2003), Rejuvenating Tanks (A Socio Ecological Approach) Books for Change, Bangalore.

[2] PrasannaChandra (2006), Projects Planning, Analysis, Selection, Financing, Implementation and Review. Sixth Edition (Chapter 8.1 to 8.11)

[3] Campbell D.E. (1984), Pipe distribution systems in ground water development. *Agricultural Administration* Vol.16, pp 209-227

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