A STUDY ON DEMAND WATER SUPPLY THROUGH BURIED PIPE SYSTEM FOR EFFICIENT IRRIGATION IN A COMMAND AREA OF A TANK

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Abstract

The tank command areas of south Karnataka are vulnerable for erratic rains and insufficient supply of water, because of losses to the extent of 50 per cent due to seepage, percolation and evaporation in transit from the storage reservoir to the farmer's field. In order to minimize the losses in conveyance of water from the source to the target site, the buried pipe distributory systems have been designed and developed, which is the first of its kind for tank command irrigation with the adoption of solar pump to lift water from the jack well in order to reduce the dependence on the erratic electric supply at village level. The improved conveyance systems and advanced irrigation systems, which involve designs, construction, and field studies on agriculture with different perspective have been studied. The effect of on-demand water supply on different crops yield during kharif and rabi/summer 2003-04 to 2007-08 indicated that there was a significant change in the yield of crops and cropping pattern in command area due to intervention of on-demand water supply

***Keywords**: Water Supply, Efficient Irrigation, Command Are, Water Use Efficiency*

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1. INTRODUCTION

An investigation on the On-demand water supply system and efficient irrigation methods were carried out during 2003-04 to 2007-08 at Chunchdenahalli tank command area situated adjacent to Chunchadenahalli village, Kolar district. The present study was carried out with th objectives of i). to study the existing irrigation distribution system, ii). to introduce on-demand water supply through buried pipe system for efficient irrigation in the command area of tank to avoid conveyance losses, iii). to study the water conveyance efficiency and water use efficiency for channel irrigation, buried PVC pipe systems, surface, sprinkler and drip irrigation systems, iv). to investigate the effectiveness of on-demand water supply (under ground pipe and advanced irrigation systems) for water saving and v). to study the economic viability of on demand water supply system in a tank command area.

2. DETAILS OF STUDY AREA

The study area chosen was Chunchdenahalli tank, Kolar district, which is one of the drought affected districts in Karnataka and has more number of irrigation tank (Raju et. al., 2003).

Chunchdenahalli tank situated adjacent to Chunchadenahalli village in Vakkalerihobali, Kolar taluk, Kolar district. Fig.1 shows the location map of the study area. The catchment area and command area of the tank geographically stretches between 13^{o} 5' 40" and 13^{o} 8' 15" N Latitude and 78^{o} 1' 30" and 78^{o} 4' 5" E Longitude.The tank is covered in Survey of India toposheet No. 57 K/4 on 1:50000 scale. The tank is situated in Seasandra sub-chain series of Palar basin. Hydrogeologically the tank watershed area is situated in granite gneiss and it is moderately weathered and highly jointed. Larger area of the catchments is hilly with red sandy loam soil and the depth of the soil varies from 7.5 to 22.5 cm (Kamath, 1989).

2.1 Chunchadevanahalli Tank Command Area

The Chunchadenahalli tank has an independent catchment area of 544 ha and water spread area of 12.5 ha (Fig. 2). The command area contains 23.37ha, which is owned by 75 farmers. The total length of the tank bund is 776.84 m. There were two waste weirs, one is located in the right side of the bund measuring 30.3 m, and other in the left side of the bund measuring 26.3 m. The tank has three sluices, one is located in the middle and the other two are on either side of the bund. The cisterns are rectangular in shape for each sluice on the down-stream side of the bund from where the main channels are connected. There were five main irrigation channels and ten sub channels. 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. The total rainfall received during the years, 2003 to 2008 varied from 462.2 to 1188.1 mm. The highest rainfall of 1188.1 mm was received during 2004. The water discharge from the bore wells in command area shows that the bore wells water yield was highest during 2004 to 2006 by recording 3.68 to 4.54 l/sec(Radhakrishna, 2012).

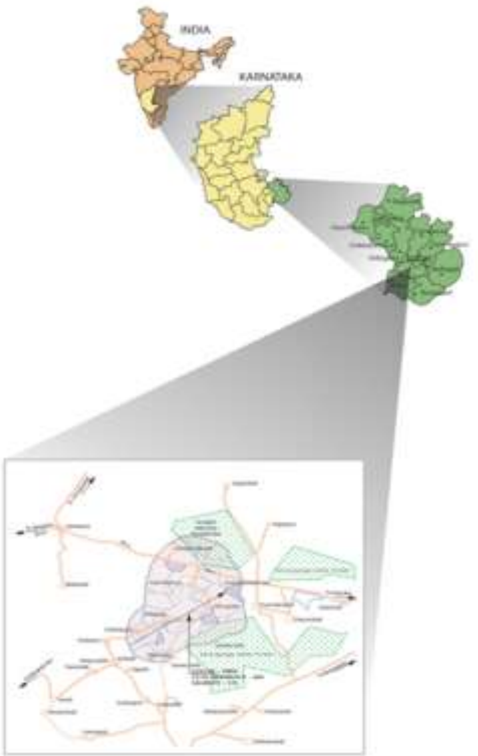

Fig. 1 Location map of study area

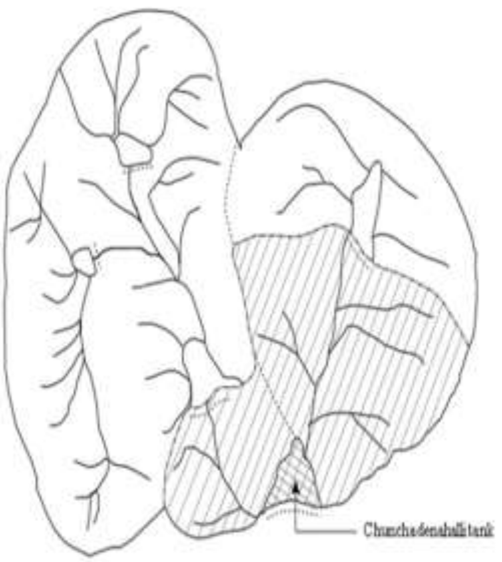

Fig. 2 Independent command area

3. DESIGN OF BURIED PIPE DISTRIBUTION SYSTEM

The entire command area was divided into five sections so that water can be given to each section once in five days and also to reduce the cost of pipe system considering 148 existing plots consisting of 65 farmers in the command area. The salient features of the command area and the existing land profile, the main channels and sub channels were considered while designing the buried pipeline system. Fig. 4 and Fig. 5 shows the cropping pattern when the tank in full and tank in half respectively.

Fig. 3 Buried pipe distributor system and outlets

4. CONVEYANCE EFFICIENCY OF BURIED PIPE SYSTEM AND OPEN CHANNEL SYSTEM

The data on the conveyance efficiency of open channel and buried pipe system (Table 1) revealed that the conveyance efficiency of water was comparatively highest in buried pipe system compared to open channel by recording 93 to 97 per cent and 55 to 72 per cent efficiency, respectively. The findings of the present investigation are in agreement with the results of Campbell (1984). Murthy (2002) also stated the use of underground pipe line system (also known as buried pipelines) for conveying irrigation water on the farm for effective irrigation. The main advantages of the buried pipe line irrigation systems are saving of land and water, elimination of seepage losses and relatively little maintenance cost.

5. EFFECT OF ON DEMAND WATER SUPPLY SYSTEM AND EFFICIENT IRRIGATION ON WATER USE

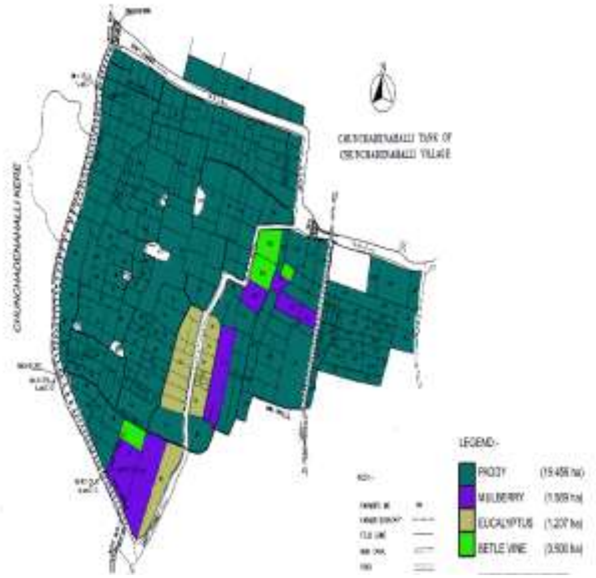

Fig. 4 Cropping pattern (tank is full)

Fig. 5 Cropping patterns (tank is half)

On-demand water supply system and efficient Irrigation (Table 2) has shown significant change in WUE in Chunchadenahalli tank command area (2003-04 to 2007-08). During 2003 kharif, the WUE of 18.5 kg/ha cm and 13.0 kg/ha cm in paddy and mulberry, respectively. However, during 2007 the WUE was 88.12 and 39 kg/ha cm in paddy and mulberry, respectively. During 2004, the WUE of paddy 20.5 kg/ha cm followed by cauliflower (625 kg/ha cm). While WUE of paddy 30.7 kg/ha cm during 2005 (approximately 50 per cent more), cabbage 1661 kg/ha cm. During 2006, tomato yield with a WUE of 1857 kg/ha cm followed by cauliflower WUE of 2250 kg/ha cm and capsicum 625 kg/ha cm, respectively. During 2007, tomato yield with WUE 1089 kg/ha.cm followed by cauliflower, coriander, redgram (vegetable), field beans with WUE of 2034, 1600, 239.0 and 250 kg/ha.cm, respectively.

Table 1 Comparison of conveyance efficiency of open channel and underground pipe system

Open channel			Pipe system		
Water let into the channel	Water let out into the channel	Conveyance efficiency (%)	Water let into pipe	Water let out from pipe	Conveyance efficiency (%)
16	8.8	55	3.3	3.1	93
16	9.76	61	3.3	3.2	97
16	11.52	72	3.3	3.2	97
16	11.52	72	3.3	3.1	93
16	11.03	69	3.3	3.2	97
Average 16.00	10.81	67	3.7	3.18	95.4

Table 2 Water use efficiency (kg/ha cm) over the years 2003-2008

Crop	2003-04	2004-05	2005-06	2006-07	2007-08
Paddy	18.5	20.5	30.7	122	80.6
Ragi	67	78	46.4	87.5	103.85
Jowar	45	-	-	-	-
Betel vine	1.2	1.2	1.35	3.5	-
Mulberry (Cocoons)	13	13	25	42.5	39
Cauliflower	-	652	-	2250	2034
Capsicum	-	-	158	625	-

Chillies	-	-	105	-	-
Radish	-	-	-	888	-
Tomato	-	-	562	1857	1866
Cabbage	-	-	1661	-	-
Coriander	-	-	-	-	1600
Red gram	-	-	-	-	239
Field bean	-	-	-	-	250

The water use efficiency was worked out for all the crops based on the total water consumed and the yield obtained during Kharif 2007.The paddy crop grown under SRI (on and off) method of paddy cultivation on an average consumed about 86.6 ha.cm of water with a water use efficiency of 80.6 kg/ha.cm. While transplanted ragi crop recorded on an average of 31.7 ha.cm, with a water use efficiency of 110Kg/ha.cm, the rainfedragi with 24.2 ha.cm of water with a WUE of 97.7 q/ha.cm. The difference in WUE in case of rainfed and transplanted ragi may be attributed to protective irrigation during critical stages of crop growth and whenever there was long dry spells in between the two rainfall. The mulberry crop which was grown both under surface and drip irrigation, on an average required 16.7 ha.cm of water with a WUE of 39 Kg cocoons/ha.cm. Among vegetables the tomato crop could utilize only 35 ha.cm (Drip irrigation) of water with a WUE of 1866 Kg/ha.cm. Cauliflower requiring about 22 ha.cm (Drip irrigation) with a WUE of 2034 Kg/ha.cm. Less WUE in case of cauliflower may be attributed to 3 per cent mortality of saplings in the early stages. Coriander grown as greens required 25 ha.cm with a WUE of 1600 bundles/ha.cm. While redgram (vegetable) required 33.5 ha.cm with a WUE of 239 kg/ha.cm. Field beans grown as pure crop on an area of 1 ha under rainfed condition could utilize 28 ha.cm of water with and a WUE of 250kg/ha.cm. The findings of the present investigation are in agreement with the facts of (Anon.,2006) in increasing the crop yield and drip irrigation revolution will go a long way in creating perfect water use discipline in the state and help to reap advantages like Israel.

6. RESULTS AND DISCUSSION

The tank command areas of south India are vulnerable for erratic rains and insufficient supply of water, because of losses to the extent of 50 % due to seepage, percolation and evaporation in transit from the storage reservoir to the farmer's field. In order to minimize the losses in conveyance of water from the source to the target site, the buried pipe distributary systems have been designed and developed, which is the first of its kind for tank command irrigation with the adoption of solar pump to lift water from the jack well in order to reduce the dependence on the erratic electric supply at village level.

The buried pipe distributary 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/cm^2 and 4 Kg/cm^2 pressure class of IS-4985 have effectively irrigated the entire command area (24.0 ha) compared to open channel irrigation system. Adoption of buried pipeline distributory systems had lead to the reduction in water transit and distribution losses, reduction in the land area taken up by the distribution system and reduction in the maintenance and operating costs of the irrigation system. Murthy (2002) also opined that buried pipe line systems were used for conveying irrigation water on the farm worked efficiently. The main advantages of buried pipe line system are saving of land, elimination of seepage losses, and relatively little maintenance need.

The efforts made on implementation of buried pipeline system had led to the reduction in water consumption for paddy and encouraged high value crops in the command area. In supportive to present investigation, Campbell (1984) reported that pipe systems in northern India assured flow delivery at the design discharge to the furthest irrigator with a minimum losses and unauthorized diversions en route.

7. CONCLUSION

The conveyance efficiency of open channel and under buried pipe system indicated that the conveyance efficiency of water was comparatively highest in under ground pipe system as against open channel by recording 93 to 97 per cent and 55 to 72 per cent respectively.

The effect of on-demand water supply and efficient irrigation systems has shown significant change in WUE in Chunchadenahalli tank command area (2003-04 to 2007-08). During kharif 2003, the WUE of 18.5 kg/ha cm and 13.0 kg/ha cm has been recorded in paddy and mulberry respectively. However, during 2007 the same crops recorded the WUE of 88.12 and 39 kg/ha cm in paddy and mulberry respectively.

The water use efficiency based on the total water consumed and the yield obtained indicated that paddy crop grown under SRI (on and off) method of paddy cultivation consumed on an average of about 86.6 ha.cm of water with a water use efficiency of 80.6 kg/ha.cm. While transplanted ragi crop recorded on an average 31.7 ha.cm, with a water use efficiency of 110Kg/ha.cm, the rainfed ragi with 24.2 ha.cm of water with a WUE of 97.7 q/ha.cm. The mulberry crop which was grown both under surface and drip irrigation, on an average required 16.7 ha.cm of water with a WUE of 39 Kg cocoons/ha.cm. Among vegetables the tomato crop could utilize only 35 ha.cm (Drip irrigation) of water with a WUE of 1866 Kg/ha.cm

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