IWMI-TATA WATER POLICY RESEARCH PROGRAM

ANNUAL PARTNERS' MEET 2002

Techno-Economic Feasibility of Groundwater Over-Exploitation in Tamil Nadu

K Palanisami

International Water Management Institute

TECHNO-ECONOMIC FEASIBILITY OF GROUNDWATER OVER-EXPLOITATION IN TAMIL NADU

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Abstract

Groundwater, a critical source of domestic and irrigational use, plays a vital role in supporting the livelihood of the poor. Nevertheless, increased use of water for domestic and industrial purposes, and depleting levels of water table are adversely affecting the small and marginal farmers of Tamil Nadu. This paper forwards suggestions regarding policies to minimize over pumping as well as to generate revenue for the Tamil Nadu Electricity Board.

1.0 Introduction

Groundwater, a critical source of domestic and irrigation water, plays a vital role in supporting the livelihood of the poor. However, the intensity of groundwater exploitation is not sustainable in many regions of Tamil Nadu. Decreasing access to groundwater caused by a sustained decline in water levels or the failure of wells earlier in the dry season, disproportionately affects small and marginal farmers.

The total geographical area of Tamil Nadu State is 1,30,069 sq.km. Administratively this State has been divided into 22 districts, which are further sub-divided into taluka and blocks. In all 384 blocks exist in the State. The surface water resources are fully harnessed by impounding the available water in 61 major reservoirs and also in 39,202 small and big tanks. The state receives only a moderate rainfall. The intensity of rainfall is high during north-east monsoon, moderate during south-west monsoon and low during north-east monsoon, moderate during south-west monsoon and low during transition. Based on a 70-year rainfall record, the average annual rainfall seems to be 925 mm (Table 1). Tamil Nadu has three distinct rainy seasons viz. southwest monsoon from June to September, North-east monsoon from October to December and transitional season from January to May. The maximum rainfall occurs during North-east monsoon.

Table 1. Season-wise rainfall in Tamil Nadu

Rainy seasons	Period	Rainfall (mm)	% of total rainfall
Transitional	January to May	178.7	19.3
South-west Monsoon	June to September	307.6	33.3
North-east	October to December	438.7	47.4
	Total	925.0	100.00

2.0 Water Supply and Irrigation

There are 32 medium and minor river basins and 1 major river basin in the state and the available surface water potential is estimated to be about 35741 Million cubic meters (MCM) out of which surface water potential within the state is about 23608 MCM and import from the adjacent states accounts for about 12133 MCM. More than 98% of the surface potential has been already utilized. The irrigation from groundwater resources has already reached an extent of 1.13 m.ha. The supply demand gap in water was estimated to be about 1.3 m.ha.m or about 24% in year 2015 AD (Palanisami et.al., 2000).

Minor irrigation development was 1.22 m.ha under groundwater and 0.85 under surface water. Net area irrigated during 1993-94 was about 2.8 m.ha, out of which canals accounted for 29.1 %, tanks 23.9% and wells 46.4% and others 0.6%.

2.1 Groundwater potential

While estimating the groundwater potential, 15% of the total dynamic groundwater resources has been kept reserved for domestic and industrial uses. Out of total groundwater resources of 26395 MCM/year, total quantity of ground water resources earmarked for all districts of Tamil Nadu for drinking and industrial uses worked out to be 3962 MCM/year and the drinking water need worked out to be about 952 MCM/year.

The assessment for ultimate demand for public health and industrial uses depends on the population growth and industrial expansion. The rate of population growth as per census studies indicates 1.5 per cent per annum. The present demand for domestic need is 952 MCM/Year. A similar quantity is assumed for industrial sector. The total requirement for drinking and industrial uses is anticipated to be 1904 MCM/annum.

Assuming a projected increase in demand of water supply by 3 percent both for domestic and industrial use, the total water requirement for year 2015 AD will be an additional 800 MCM leading to total requirement of 2704 MCM. The irrigation potential created from groundwater is estimated as 1.954 m.ha and the balance irrigation potential available is 1.19 m.ha. The ultimate irrigation potential available from ground water in Tamil Nadu works out to be 3.144 m.ha. Average development is about 60% and it ranged from 7% to 100%. Water table also fluctuates between open and dug wells where the fluctuations range from 0.5 to 1.0 m/year.

3.0 Well Development and Energization

The number of groundwater abstraction structures have shown a phenomenal rise from 1950s to 1990s. This is evident from the fact that in Tamil Nadu the number of dug wells has increased from 0.79 million to about more than 1.8 million and the shallow tube wells from a few hundreds to 0.14 million in the last four decades.

Such a phenomenal increase in the Minor Irrigation development by groundwater was accomplished by means of rapid energization of pumpsets and availability of institutional finance mainly for medium and small farmers. The total number of energized wells during 1950-51 was nearly 0.1440 millions, whereas it was about 1.6 million during 1998-99 compared to 9.10 million energized wells in the whole of India.

Energization has helped the groundwater exploitation on a large scale In about 89 out of 384 blocks, the level of groundwater development is more than 85% (categorized as dark) of utilizable groundwater resources, in about 86 blocks the groundwater development varies between 65% and 85% (categorized as grey) and in the remaining 299 blocks the level of extraction is less than 65% (categorized as white).

4.0 Power Consumption and Revenue

Gross power availability in 1997-98 was 34065 million units. The net power available for consumption in the state is about 78.5% of the generation, the balance being sale to other states and distribution/transmission losses. Per capita per availability has increased from 220 kwh in 1985-86 to 430 kwh in 1997-98 (Table 2).

Table 2. Consumption of power, Tamil Nadu (million units)

Category	1993-94	1997-98
Domestic	3149	4169
Commercial	1055	1683
Industrial	8210	11098
Agriculture	5618	7275
Others	2128	2515
Total	20157	26740

Source: Tamil Nadu-An Economic Appraisal 1997-98

4.1 Tariff system and consumption of electricity

Pro-rata system was followed till early 1980s. Small farmers were charged at Re 0.13/kwh compared to Re 0.15/kwh levied on large farmers. In 1984, flat rate system (Rs 75/HP/year) was introduced for farmers other than small farmers, for whom free electricity was introduced. But once again in 1990 the system was revised based on HP of the pumpset as Rs. 50/HP/annum for the farmers who own up to 10 HP pumpsets and Rs.75/HP/annum for the above 10 HP farmers. However, from 1.9.91 onwards, government announced free electricity for all types of farmers.

The impact of electricity tariff on the consumption of electricity was examined by taking into account the number of electric pumpsets and total quantum of electricity consumption by agriculture sector for selected years. During the pro-rata period (1980-81), the consumption of electricity per pumpset was 2583 kwh however, consumption of electricity has increased 10 per cent in 1985-86 after the flat was announced. Further, introduction of free electricity has increased the consumption of power from 3336 Kwh/pumpset in 1991-92 to 4546 Kwh in 1997-98 which is a 16% increase after the free electricity was announced (Table 3). The increase was both due to additional pumping as well as due to increased lift. It was estimated that about 32% is due to additional pumping and 68% due to increase in lift.

Table 3. Consumption of electricity by agricultural sector, Tamil Nadu

Year	No. of pumpset (million)	Power consumption (m.kwh)	Power consump./pumpset (kwh)	net area irri. By wells (m.ha)	Power consump./ha (kwh)	Area irri./pumpset (ha)
1970-71	0.5100	1241	2433	0.774	1603	1.52
1980-81	0.8937	2299	2583	1.067	2154	1.19
1984-85*	1.0081	2415	2415	1.00	2398	0.99
1985-86	1.0488	2804	2670	1.00	2722	0.98
1989-90	1.2521	3190	2547	1.169	2728	0.93
1990-91#	1.2932	3974	3080	1.059	3752	0.82
1991-92@	1.3343	4451	3336	1.168	3810	0.88
1992-93	1.3783	5160	3739	1.201	4290	0.87
1993-94	1.4483	5635	3891	1.300	4335	0.90
1997-98	1.6079	7275	4546	1.41	5160	0.88

* no charge for small farmers and Rs 75/HP/annum for others;
\# Rs 50/HP/annum for upto 10HP and Rs 75/HP/annum for >10 HP @ from 1.9.91 onwards free electricity to all farmers.

When electricity is available free of cost or at lower cost, the marginal cost of water will be near zero. This will induce the farmers to operate more hours and reduce the efficiency of water use. The working group of minor irrigation for the Eighth Five Year Plan has also indicated that flat-rate would make farmers waste water and induce them to take crops requiring more water (GOI, 1989).

Consumption of electricity either at a flat rate or at free of cost will be different to different categories of farmers. It will be higher for bore well or tube well owners and wherever the recharging capacity is higher and the chances of over-use will be more in these areas. Among the various input subsidies, electricity subsidy is the only subsidy which reaches the farmer without leakages, since this goes directly into the farmer's hand. Moreover, any increase in electricity tariff would ultimately affect the small and marginal farmers particularly those who own dug wells. Hence if government wants to increase electricity tariff (when no other option), they can fix it based on the type of water extracting mechanisms viz.,borewell with pumpset, submersible pumpset with deep borewells, horse power of pumpset and consumption of electricity (flat system). This will also satisfy our macro plan objective namely growth with equal distribution.

4.2 Pricing and electricity consumption

Many studies have shown that flat rate makes the marginal cost of water zero, hence, it allows indiscriminate use of groundwater. Over exploitation and mis-use of water depend upon many supply and demand factors like number of hours of electricity supplied, cropping pattern of borewell and non bore well farmers, availability of surplus water etc. Unconstrained supply of electricity is the prime factor responsible for mismanagement of water in areas where abundant groundwater potential exists.

A detailed analysis was undertaken using the sample wells from the Lower Bhavani Project (LBP) in Periyar district, Tamil Nadu to compare the cost saving by the farmers with different motors (HP) due to free electricity supply.

The mean average energy consumption based on a sample of 33 wells in the Lower Bhavani Project (LBP) command area is 6852 units (kwh)/year with a minimum of 1658 units by 3 HP motors to a maximum of 9803 units by 10 HP motors. However, with the increased pumping capacities, the rate of discharge per unit time increases and the rate of discharge per unit area decreases. The mean extraction is 7 M^3 per unit of electricity consumed. The variable cost towards lubrication oil and repairs and maintenance amounts to Rs 375.5/year/well with 3 HP and it is Rs 594.2 with 10 HP. Average electricity consumption is 6852 units (kwh)/year/well. Cost of electricity at the old rate of Rs 0.15/kwh under different HPs is Rs 248 with 3 HP and Rs 1470 with 10 HP motors. Cost under flat rate system is Rs 75/HP/Year. Comparing the different HPs, farms with higher HPs could only capture the benefits under flat rate as well as free power situations (Table 4).

Table 4. Energy Consumption by wells in canal system, Tamil Nadu

HP of pump	No.of pumps	Energy consumption (units/year)	Average discharge		Variable cost (Rs/well/year)
			(M^3/hr)	(M^3/unit)	
3	3	1658	20.2	9.0	276.3
5	13	2413	28.5	7.7	278.1
7.5	10	7957	34.5	6.2	393.5
10	7	9803	44.5	5.8	393.8
Average	33	6852		7.0	

Variable cost= cost towards lubrication oil and repairs & maintenance.

It was observed that the water use was inelastic to tariff changes (Table 5). This had indicated that the profitability of the crops is higher compared to energy costs under different tariff systems, as the energy cost amount to only less than 5% of the cost of cultivation of crop. However, farmers in groundwater over-exploited regions such as Coimbatore had reported that the energy cost amounted to 20% of the cost of cultivation. Data were not available in other locations and crops, as water use were different in different locations.

5.0 Economics of Irrigation

Average cost of a private borewell including pumpset in the state worked out to be about Rs 75,000 and the maintenance cost was Rs 2100/year. In the case of community wells, which costs 2 -3 times higher than the private wells, total hours pumped were 3234/year and the water sold was about 742 hrs. Cost of water from the community wells is about Rs 3/hr compared to Rs 10 in private wells. Comparison of the water use and yields were made for the canal, tank and well irrigation systems in the state. Periyar district recorded the maximum product per unit quantity of water due to effective utilization of water and higher production (Table 6).

Table 5. Economics of irrigation under different electricity pricing in canal system, Tamil Nadu

	PUMP			
Particulars	3 HP	5 HP	7.5 HP	10 HP
1.Farm size (ha.)	1.6	2.1	4.2	4.5
2.Energy used(kwh)	1658	2413	7956	9803
3.Area of crops(ha):				
1. paddy	0.51	0.87	1.3	1.2
2. sugarcane	0.42	0.78	1.4	1.8
3. groundnut	0.65	0.87	1.3	1.2
4. cotton	-	-	0.3	0.5
5. turmeric	-	-	0.5	0.4
Total cost of production (Rs)	18306	30808	69749	76015
Total returns (Rs)	36231	61575	125678	155036
Gross margin(Rs)	17925	30767	55929	79021
7.Electricity charges(Rs):				
a.unit rate	248.7	362.0	1193.5	1470.5
b.flat rate	225.0	375.0	562.5	750.0
c.free supply	0	0	0	0

Note: the data is based on sample farms in Lower Bhavani Project area; cost of cultivation does not include electricity charges;

6.0 Water Markets and Groundwater Use

Groundwater markets exist mostly in tank command areas as the tank water is not sufficient for irrigation and wells are used as supplemental source. Wells in the tank command area are dug wells with 10 to 20 meters depth and as private investment, they are owned by about 15% of the farmers who are mostly large landowners. Groundwater development is one of the important components in tank irrigation as groundwater supplementation is gaining importance in tank irrigation. Since most of the farmers have standing crop in the field when the tank water supply is exhausted, groundwater supplementation is the only alternative to save the crop.

Table 6. Elasticity of water use With respect to electricity tariff

Electricity tariff (Rs/hr)	Elasticity Ewt
0.1	-0.035
0.2	-0.073
0.3	-0.113
0.4	-0.158
0.5	-0.207
0.6	-0.257
0.7	-0.313
0.8	-0.376
0.9	-0.444
1.0	-0.519

The intensity of supplementation in the first season as well as the demand for water for second season crop is such that the number of wells in the tank command has just tripled during 1960-61 to 1998-99. In several cases, decline in the tank performance has compelled the farmers to go for well supplementation; but it is also true to some extent that the increase in the number of wells has resulted in poor performance of the tanks as farmers were not united in sharing the tank water. Of course, better pumping and drilling technologies, credit facilities from commercial banks and individual management instead of group management also contributed for the growth in well irrigation.

The well owners who are the only suppliers of groundwater to a group of farmers located around the well, act like autocrats. Location of the wells and the limited number of wells in most locations make each well owner somewhat like a monopolist. The high cost of well digging is a barrier to entry particularly for small and marginal farmers. The effect of well interference during pumping is reflected in the water availability and price and the well owners maximize their profits with respect to variations of either water output(hours) or price. Well owners can't set both independently since price is uniquely determined by the demand curve once the level of output is selected based on past experience and well recharge behavior. Reductions in pumping (up to a certain level) can increase the water price resulting in higher profit.

The water market is more common in tank commands. The method of pricing to be followed depends largely on the tank water availability and location of the wells**.** During deficit supply periods well owners follow the share basis for pricing water because more supplementary irrigations will be required during the later part of vegetative period and entire reproductive period. While during normal supply period, well owners will follow the cost (Rs per hour) basis for pricing water as the average number of supplementary irrigation required will be comparatively low. All the well owners generally charge more or less the same price irrespective of the number of sellers in the area.

6.1 Cost of irrigation: Diesel vs Electricity sources

Pumping water with the use of diesel sets is common in tank commands where the water table is comparatively shallow. Cost of pumping varied from Rs 6 to 9/hr in the case of owners of diesel pumpsets and cost of 4 supplemental irrigations for rice in the tank command worked out to be Rs 240 to 320/ha. The selling price, however, was ranging from Rs 25 to 35/hr depending upon the water scarcity and crop season and the average cost per ha for 4 supplemental irrigations for rice worked out to be Rs 1000 to 1200/ha. In the case of electricity sources, the cost per hour worked out to be Rs 1 to 1.5 and for the 4 supplemental irrigations, it worked out to be Rs 40 to 60/ha which indicates the cost effectiveness of electric power.

Due to limited availability of well water, the well owners can sell water only to a limited number of buyers. A buyer can approach the seller whose well is nearer to his field and the seller can increase the price for well water depending upon the demand for it. The monopoly power of the well owners was determined by the ratio of sale price to average cost. This ratio was 2.69 and 2.04 during deficit and normal supply periods respectively. This confirms the high monopoly power of the well owners.

Regarding the share of farmers income to irrigation cost, 2 to 59 % was accounted in deficit supply year compared to normal supply year (Table 7).

Table 7. Well owner's share in irrigation benefits Tank irrigation system, Tamil Nadu

Details	No. of supple. Irrigation	Total cost		Well owner’s share	
		AC	Wpp	Rs	per cent
Deficit supply:					
	4-6	364	438	74	2.15
	6-8	-	-	-	-
	8-10	614	1251	637	15.00
	10-12	657	1360	703	16.00
	12-14	1092	1856	764	59.00
Normal supply:					
	3	348	349	1	3.00
	5	645	720	75	3.00
	6	697	761	64	4.00

Note: AC = Average cost of pumping; Wpp = Well owner's selling price.

Given the high water prices and varying pumping hours, it is important to know at what level of pumping and prices do the well owners maximize their profit. The (inverse) demand and output functions from the simultaneous equations systems were used to derive the profit maximizing levels of well yield, quantity available for pumping and price.

In the case of deficit supply period, profit from water sales is maximized when the water level in wells does not drop below 3.6 meters and this corresponds to about 252 hours of pumping. Any quantity higher than this will reduce the well owners profit. In the case of normal supply period, profit from water sales is maximized when the water level in wells does not drop below 1.5 meters and this corresponds to about 92 hours of pumping. Any quantity higher than this will reduce the well owner's profit.

Deficit supply period WY = 3.6 m;
QP = 252 hours/month;
PP = Rs 190.22 per ha./per/ month

Normal supply period WY = 1.5 m;
QP = 92 hours/month
PP = 1352.7 per ha./per/month

7.0 Pumps and their Efficiency

It was found that the diesel driven pump sets were running with an average overall efficiency of 12.7% and that of electrically driven pumps at 32.1%. Thus, there is a tremendous scope to improve the efficiency of the pumps and on the other hand conservation of energy.

The pumping systems in the state is inefficient mainly due to the following reasons:

a. efficiency of the pump set is low as small vendors entice the farmers with cheap non-ISI pumping sets;

b. pump set is not operating at its maximum efficiency range. This is due to improper selection of the pump sets which does not match the water source and usage;
c. the pipe lines and fittings are selected smaller in diameter for economic reasons than recommended. This leads to wastage of energy due to high liquid velocity;
d. poor quality of electric power supply. Large voltage variations over a range of less than 200 V to 440V on a three phase supply where large phase to phase voltage differences also exist. This makes the motor over size for a particular application and runs on part load over a period with low efficiency;
e. installation and maintenance of the pumping system is of poor quality. The rural plumber / mechanic / electrician is not trained in proper installation and maintenance of pump sets and the system. This leads to reduction of efficiency of the system over a period.

To improve the quality of pump set, prime mover spare parts, the manufacturers are to be contacted with the specific requirements and possible line of failure, so that the products can be more efficient and foolproof. Indian Bureau of Standard may be appraised time to time with the specific requirement in the field and usual case of failures for further improvement of the product and to ensure about the product of ISI mark or registration.

The role of farmers and Government agency is important in conserving the energy. As such, there is a scope of increasing efficiency by 30%. Even if it is considered that the efficiency of electrically driven pumps are increased by 15% and that of the diesel driven pumps by 10% there will be a saving of equivalent amount of energy i.e 11x10 Kwh electrical energy and 1.15x10 litres diesel per annum. If a target is fixed to improve the efficiency of 50% pumps available by year 2010. there will be a total saving to the tune of 5.5x 10 Kwh electrical energy and 5.75x10 liter of diesel per annum. The target is quite realistic and achievable. Considering the average production and transmission cost of electricity Rs 2/KWh and cost of diesel Rs 8/lit then there will be a saving of more than Rs 5800 millions in electrically driven pumps and 2900 millions for diesel driven pumps per annum in the next ten years.

8.0 Regulatory Instruments and Procedures Currently in Force

Spacing norms have been prescribed based on the guidelines issued by NABARD (National Bank for Agricultural and Rural Development) for adoption between and two minor irrigation structures. These range from 150 m (for any two dug wells) and 600 m (for any two deep tubewells). These spacing norms are applicable for the state of Tamil Nadu as a whole for the construction of new structures for development of groundwater for minor irrigation purposes availing institutional finance.

These spacing norms are followed even for deepening of existing old wells. However spacing need not be observed for deepening of wells where institutional finance has already been availed for digging of well itself. The construction of new wells will be permitted only in white category blocks in view of increased exploitation.

Groundwater development has been extensive in the coastal districts in view of the favorable hydrological condition existing along the coastal area over extraction in the coastal area may lead to sea water instrusion and management strategy is to be adopted in this zone. As a precautionary measure, certain restrictions have been imposed for financing for minor irrigation schemes involving development of groundwater to a distance of 10 km from the coast. The following are the spacing norms recommended by NABARD.

Prescribed distance between wells as per NABARD (in M):

- Between two open wells : 150
- Between two less deep tube wells : 175
- Between medium deep tube wells and very deep tube wells : 600
- Between less deep tube wells and medium deep tube wells : 387.5
- Between two filter points : 175
- Between two tube wells and open well : 175
- Between two medium deep tube wells : 600
- Between two very deep tube wells : 600
- Between open wells and less deep tube wells : 362.5
- Between open well & medium deep tube well : 375
- Between open well & very deep tube well : 375

9.0 Issues for the Future

Over exploitation of the groundwater in several locations coupled with free electricity has resulted in decline in groundwater tables, besides making the Tamil Nadu Electricity Board (TNEB) running on heavy losses. Water use efficiency is also low in several crops as the marginal cost of pumping is almost zero. Appropriate policies are needed to minimize the over pumping as well as to generate revenue for the TNEB. The following issues may be relevant for efficient functioning of water markets:

1. How to control over exploitation of groundwater due to excessive pumping using high Powered motors?

2. How can water allocation be effectively done to balance the surface and ground water withdrawls keeping in mind rural and urban interest.

3. How should tank management be improved by repairing the sluices, adopting rotation method, removing foreshore encroachments .How best this will help in recharging the wells.

4. How could well owners be convinced to fix the price for well water at average cost. This is still profitable to the well owners as marginal cost is very low (or) negligible as electricity is free to them.

5. How could institutional intervention help increase the number of wells in the tank Command area. This will help in reducing monopoly power of the well owners because with more wells the demand for water from each individual well will fall,

resulting in a lower well water price and higher profit for the small and marginal farmers.

10.0 Conclusion

In view of the above problems it is felt necessary that some management strategies be adopted:

1. Regulation in the utilization of groundwater by way of legislation: At present, only in the case of digging wells/constructing boreholes availing the institutional finance, groundwater discipline like spacing are enforced. But in Tamil Nadu the groundwater development is mostly by private individuals with their own finance. Hence virtually no groundwater discipline is being followed in the development of groundwater for minor irrigation purposes. Hence, groundwater legislation is a must to regulate groundwater development in Tamil Nadu.

2. Watershed programs to augment the groundwater recharges: It is essential to undertake artificial recharge schemes on a large scale in critical areas wherever the depletion of groundwater level has been reported beyond replenishable limit.

The commonly adopted method for artificial recharge is construction of percolation ponds, checkdams through watershed management activities. The agricultural engineering department has already constructed about 10,000 percolation ponds in the state. The scope for constructing further percolation ponds in areas where surplus surface water is available can be explored. Other methods like injection of water into groundwater systems can be examined in sedimentary areas. Development of decision support system models will help in the location of major and minor check dams as well as percolation ponds in the watershed locations. Since in the state, the rainwater harvesting is linked with the watershed programs involving watershed associations at village level, such models will help ensure productivity and equity aspects of groundwater development.

3. Arresting of further development of groundwater in dark area blocks. Altogether 175 blocks are falling in dark and grey area category. Immediate steps need to be taken in dark and grey area blocks to arrest any further development of groundwater. Again, in the absence of groundwater legislation it is very difficult to regulate the groundwater development in these critical areas.

Pending the enactment of groundwater legislation by government, some restrictions can be imposed on energization of pumps etc. especially for agricultural purposes. Groundwater clearance by the groundwater department may be insisted before Tamil Nadu Electricity Board energizes a well. Further energization of well in dark blocks may be stopped to safeguard the exiting groundwater structure.

4. Conjunctive use of surface water and groundwater: The development of groundwater in these command areas is not as high as compared with non-command areas. Groundwater resources available in command area can be utilized in conjunction with surface water and there will enable either to increase the command area or to raise additional crops. Both canal and tank command areas should be exploited by putting additional wells.

5. Popularizing micro-irrigation systems: The area under drip irrigation is about 35,000 ha with the water saving of about 50%. The sprinkler and drip irrigation can be utilized in dark and grey area blocks wherein the groundwater development is already in a higher side. By applying these techniques the water can also be substantially conserved for extended irrigation. Large areas can also be brought under sprinkler and drip irrigation system by covering perennial and annual crops. For this purpose the institutional finance has been provided with attractive subsidy to the extent of 50%.

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International Water Management Institute
127, Sunil Mawatha, Pelawatta,
Battaramulla, Sri Lanka.
Tel: 94-1-867404, 869080, 872178, 872181
Fax: 94-1-866854 **Email:** iwmi@cgiar.org
Website: http://www.iwmi.org

IWMI-Tata Water Policy Research Program Office
Elecon, Anand-Sojitra Road, Vallabh Vidyanagar,
Gujarat – 388 120, India.
Tel: 91-2692-29311-13
Fax: 91-2692-29311-13 **Email:** iwmi-tata@cgiar.org
Website: http://www.iwmi.org/iwmi-tata

International Water Management Institute
India Regional Office, ICRISAT Patancheru,
Andhra Pradesh – 502 324, India
Tel: 91-40-3296161
Fax: 91-40-3241239 **Email:** iwmi-india@cgiar.org
Website: http://www.iwmi.org