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## Functioning of Groundwater Market for Irrigation - A Study in Cuddalore District, Tamil Nadu

**S. Manonmani, M.A., M.Phil., and N. Malathi, Ph.D.**

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### Abstract

Ground water is expensive and relatively scarce in recent years. Due to short supply of surface water the farmers are to depend on groundwater market to irrigate their land for crop cultivation. In Cuddalore District, large number of buyers and sellers cultivate paddy, which is a water intensive crop. So, there is emergence of groundwater markets in Cuddalore district with two types of arrangements. Firstly, irrigation services are provided on the basis of demand, and water charges are levied per acre. Secondly, irrigation services are provided for the whole crop season, and fixed share of crop produced is given as water charge. However, for buyers of groundwater, area-pricing arrangement has given higher returns than that of crop-sharing as shown from the study in Panruti Block, Cuddalore District.

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## **Introduction**

Irrigated agriculture has been an essential factor for food security in the last decades. In the future, it will most probably be called upon to produce large fraction of food supply needed by the growing world population. At the same time agriculture will however have to cope with increasing competition for water.

Development of groundwater took a major stride through private modern water extraction mechanisms, ownership of which are highly skewed towards large farmers due to huge capital investment needed and relatively better consideration of land holdings among them (Dhawan 1982, and Shah, 1993). Thus small and marginal farmers and even large farmers with fragmented land holdings have to depend on tube-wells or bore-wells to irrigate their crop, which has led to emergence of an informal water market.

In India, the area irrigated by canal and tank has declined from 201 lakh hectares in the year 1998-99 to 185 lakh hectares in the year 2007-08, whereas the area irrigated by tube-well irrigation and other wells has increased from 340 lakh hectares in 1998-99 to 377.87 lakh hectares in 2007-08 (Government of India, 2009).

In Tamil Nadu, the net area irrigated has improved from 28.01 lakh. ha. in 2001-02 to 29.31 lakh. ha. in 2008-09. It is noted from the Table-1, the percentage of net area irrigated by canals and tanks has been decreased by 2.5 percent 1.2 percent respectively during the same period. The net area irrigated by wells and tube wells has increased from 51.3 percent in 2001-02 to 55.1 percent in 2008-09. The net area as percentage to net area sown and Gross area as a percentage to gross area sown had also rose to more than 58 per cent. The proportion of gross area irrigated to net irrigated (irrigation intensity) has been reduced from 1.22 in 2001-02 to 1.16 in the year 2008-09.

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**Table-1**  
**Irrigation Indicators in Tamil Nadu**

Items	2001-02	2008-09
Total Rainfall (mm)	795.2	1023.1
Net Area Irrigated (in lakh ha.)	28.01 (100)	29.31 (100)
A. Canals	8.01 (28.6)	7.65 (26.1)
B. Tanks	5.37 (19.2)	5.40 (18.4)
C. Wells & Tube wells	14.49 (51.7)	16.14 (55.1)
D. Others	0.14 (0.5)	.11 (0.4)
Gross Area Irrigated ( in ha.)	34.12	33.93
Irrigation Intensity (%)	1.22	1.16
Net Area Irrigated as % to Net Area Sown	54.15	58.12
Gross Area Irrigated as % to Gross Area Sown	54.8	58.26

Source: Season and Crop Report, Tamil Nadu 2001-02 & 2008-09

### **Emergence of Groundwater Market**

When there is short supply of canal water, farmers depend on groundwater which is available for his use in the piece of land he owns. But all the farmers need not have access to the groundwater since installing pump sets require huge investments. Even though Tamilnadu government provides electricity at free of cost all the farmers are not able to install pump sets because of huge investments. The high investment costs of electric tube-wells encouraged their owners to operate their pumps at a higher level of capacity utilization by supplying irrigation service to other farmers.

Recent proliferation of private well irrigation systems, especially in South Asia, has stimulated the groundwater transactions involving bilateral bargaining between sellers and buyers over multiple types of contacts, including output sharing contracts.

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### **Study Domain and Data Source**

Tamil Nadu shares about 4 per cent in respect of the geographical area, 7 per cent of population and 3 per cent of water resources of the country. The gross cropped area in 2008-09 accounted for about 39 per cent of the total geographical area, of which 56 percent of the land was irrigated. Average rainfall in Tamilnadu state ranges from 100-180 cm. in the east to 70-90 cm. in the west. The State comprises 32 Districts more than half of the area is irrigated by Shallow tube-wells (groundwater). About 90 percent of the rainfall occurs during the south-west monsoon. The total area of Cuddalore District is 3678 sq.km. It has 3 revenue divisions, 6 taluks,13 blocks and 880 villages. This area falls under the agro climatic conditions of east coast plains.

The study was primarily based on primary data which was collected during 2008-09 using simple random sampling technique from randomly selected Panruti block of Cuddalore District, TamilNadu. Four villages were selected from the block and from each selected village 30 farmers were randomly selected. Thus the sample size was 120. The normal rainfall of the district is 716.5 mm. North east monsoon while 373.6 mm. South west monsoon. The actual rainfall in the district is North east monsoon is 1346.1 and South west monsoon is 340.3 mm. The major sources of irrigation in the district are tube-well, canals and ordinary wells.

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### **The Structure of Groundwater Market in the Study Area**

The four villages investigated in the study area located in Panruti block, in Cuddalore District, Tamilnadu, India. The farmers in this area cultivate paddy (kuruvai and samba) sugarcane, black gram, marigold, brinjal etc. The farmers cultivate paddy in two seasons such as kuruvai and samba. In the beginning of the kuruvai season there is scanty rainfall, therefore the farmers depend on groundwater for irrigation. Whereas in Samba season they got the good rainwater at the beginning and at the end scanty rain fall. In summer season some of the farmer cultivates cucumber and black gram which needs little water.

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The dominant means of irrigation in the study area is private tube well with electric pump sets.

**Table: 2**  
**Distribution of Sample sellers and Buyers of irrigation water**

Farm size (in acres)	No. of Buyers	No. of Sellers	Total
Small(below 2.5)	52	5	57
Medium(2.5- 5)	7	17	24
Large (above 5)	1	38	39
<b>Total</b>	<b>60</b>	<b>60</b>	<b>120</b>

Source: Primary Data

In the Study area 120 farmers were investigated. Table 2 shows the distribution of sample sellers and buyers of irrigation water in study area. Many of the small farmers buy water for irrigation while large number of large farmers sells water. In the study area the farmers do not have access to groundwater and so they buy water from tube-well owners.

The household survey shows that the investment and maintenance cost of tube-well ranges from one lakh to 3 lakhs depending on the horse power of the engine and the depth of the tube-well. Most of the farmers borrowed money from commercial banks to finance their irrigation investment. Land is the most important collateral in the rural credit market and the buyers' land holdings are smaller than those of sellers in the sample, thus, the inaccessibility of credit is one of the barriers preventing the buyers from installing their own irrigation systems.

The survey shows that the average investment and maintenance cost of tube-well increases with horse power. The investment cost includes ridging cost/pump set cost, cost of electrification and cost of shed. The maintenance cost includes the material cost and the labour cost. The investment cost is not only depends on the horsepower but also depend on depth of the tube-well. In the study area the maximum depth of the tube-well is 520 feet and the minimum depth is 100 feet.

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There seems to be no social restrictions against entering into the water market. Shah( 1993), concludes from available field surveys that no discrimination exists in sales or in the quality of service on the basis of caste, political affiliation, economic and social status. This is consistent with this survey, which shows more than 70 percent transaction occurs between groups from different castes.

Two type of pricing practices fallowed by the farmers in the study area such as output pricing and area pricing. Under output pricing the buyers pay for the water by providing a certain portion of their product after the harvest of the crop. Under area pricing, water buyers pay a fixed amount of cash once per season for specified irrigation acreage for the entire season.

The type of pricing practices for water varies from crop to crop. In the study area the farmers practicing output pricing for crops paddy and groundnut. One third of the product is given by the buyer of water to the seller for these crops. Area pricing method is followed by the farmers for other crops such as sugarcane, gingili, vegetables, flowers, casuarinas, black gram, cucumber etc. The fixed charge per acre varies from crop to crop under area pricing. In the study area the irrigation cost is the major cost among the total cost of cultivation for various crops. It is given in the following table.

**Table- 3**  
**Cost Structure of Major Crops Cultivated in Cuddalore District (in Rs.)**

<b>Name of crop</b>	<b>Total Cost of Cultivation (per acre)</b>	<b>Irrigation Cost (per acre)</b>	<b>% of Irrigation cost to Total Cost</b>
Paddy (Kurruvai)	12000	5560	46.3
Paddy (Samba)	10000	3670	36.7
Ground nut	20000	3000	15.0
Sugarcane	25000	4500	18.0
	25000	3900	15.6
Gingili	2000	500	25.0

Source: Computed

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The cost of cultivation and the percentage share of irrigation cost are shown in the table-3. It is noted from the table nearly 40 to 50 percent of total cost of cultivation is for irrigation for the crop paddy both in kuruvai and in samba seasons because of the farmers depend on groundwater market for irrigation. The percent of irrigation cost in total cost is low for other crops compared to paddy. In the study area the pricing practice for paddy is crop sharing (output pricing), while the pricing practice for other crops is area pricing. This shows that the crop sharing arrangements reduces the net return to the farmers especially in paddy.

**Table-4**

**Net Income of the Buyers of Groundwater for Irrigation (in Rs. per acre) from Major Crops Cultivated in the Study Area**

Name of Crop	Gross Income from Cultivation	Cost of Cultivation	Net Income	Benefit –cost Ratio
<b>Output pricing crops</b>				
Paddy (Kuruvai)	29925	12000	17925	1.5
Paddy (Samba)	26235	10000	16235	1.6
Groundnut	40500	20000	20500	1.0
<b>Area pricing crops</b>				
Sugarcane	84000	25000	59000	2.4
Gingili	6000	2000	4000	2.0
Tapioca	77000	25000	52000	2.1

Source: Computed

Table-4 tells that the buyers of irrigation water get low income and the benefit cost ratio is also less for the crops cultivated under output pricing method, because they have to pay one-third of their production as water charge to water selling farmers. When comparing this with area pricing crops the buyers get larger net income and the benefit –cost ratio is also higher for those crops.

**Conclusion**

This paper explores the pricing practices that are followed and the investment and maintenance cost of tube-well of the sample respondents in the 4 villages of Panruti

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Block, Cuddalore District. The major findings of the study are under output sharing buyers pay higher water prices to sellers than under other type. And small farmers are not access to water by their own tube-well because of large amount is needed for installing tube-well. The study suggests that if the credit facilities available to the farmers to install pump sets by commercial banks then it would increase the number of potential sellers then groundwater prices could become lower. Thus informal groundwater market will work well if effective monitoring and contact adherence mechanisms are embedded and if a sufficient number of potential sellers exist.

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