GROUNDWATER MARKETS IN RAYALASEEMA: A NOTE

V Ratna Reddy and B C Barah

This paper is based on extensive fieldwork conducted in Rayalaseema[1] region of Andhra Pradesh during 1986-88, in connection with the project on 'Economics of Water-Sharing in Droughtprone Areas'[2], sponsored by ICAR.

The research was taken up in order to identify some of the villages where well irrigation is prominent and groundwater markets are prevalent, and the problems they face. Our visits to the villages involved meeting the village heads, farmers and visiting the wells to get first hand information on well irrigation and water sharing. A number of villages were identified in Chittoor and Cuddapah districts where groundwater markets are prevalent. However, in Anantpur it was difficult to find a village with these features as there was no water in the wells during 1986-87 consequent to severe drought conditions in the past three years. Apparently, groundwater markets are more conspicuous in non-drought years and regions. Finally, three villages were chosen for the study where fieldwork was conducted for two full years. The fieldwork was conducted by field investigators who stayed in the village throughout the survey period.

The present note draws on the experience and data obtained from these three villages during the two-year study period 1986-88.

PROFILE OF THE VILLAGES

The selected villages are Karakambadi and Kadirimangalam in Chittoor district and Kondapeta in Cuddapah district: their salient features are presented in Table 1. All the three villages are of moderate size, and are well connected by *Pucca* (surfaced) roads to the major towns/district head quarters, which are all located within 20 km. As far as the social composition of the villages are concerned, backward castes along with scheduled castes and tribes are dominant in Karakambadi village, whereas forward caste populations dominate the social structure in Kadirimangalam

1 The districts of Kurnool, Anantapur, Cuddapah and Chittoor.

2 Gokhale Institute of Politics and Economics, Pune, and Department of Economics, University of Hyderabad, Hyderabad.

(Kammas) and Kondapeta (Reddys). It has been noted here that the social structure of the villages seems to play a vital role in the development of groundwater resources. It was observed that institutional support for well irrigation is marginal in Karakambadi village when compared to other two villages. Farmers expressed their reluctance to utilise available loans in this village due to the problems faced. The specific problems are: (1) it takes much time and effort to go around the offices in order to get the sanctions, and (2) nearly 50% of the sanctioned money would go towards bribing the officials. However, there are 2-3 well-to-do farmers who acquired institutional loans. On the other hand, in the other two villages very few farmers have expressed these problems.

Table 1: Salient Features of the Three Villages

	Karakambadi*	Kadiri	Kondapeta
No of households	600	200	200
Total population (NOS)	4000	600	
Total area (acres)	1000	300	200
% of area irrigated	75	90	100
Major source of irrigation	well/ tank	well/ tank	well
No of wells	100	60	100
Major crops grown	paddy and groundnut	sugarcane paddy and groundnut	betlevine paddy and groundnut

* Karakambadi consists of 5 hamlets

Of the three villages, the two villages in Chittoor district belong to the same geo-climatic region with similar soil quality. The cultivated lands of these villages can be categorised into uplands and wetlands. Irrigated dry crops like groundnut are grown in uplands and irrigated crops like paddy and sugarcane are grown in wet lands with the help of tank as well as well irrigation. The cropping pattern of these villages is presented in Table 2. The cropping pattern in Karakambadi is dominated by groundnut, whereas it is dominated by sugarcane in Kadirimangalam, and groundnut and betlevine in Kondapeta. The difference in cropping pattern, despite similar agro-climate conditions in the first two villages may be attributed to the'poor resource base, and economic conditions prevailing in the first village.

Table 2: Cropping Pattern in the Sample Villages (%)

Crop	% of area under crops in:		
	Karakambadi	Kadirimangalam	Kondapeta
paddy	25	28	4
groundnut	66	26	53
sugarcane	5	46	-
betlevine	-	-	43
others	4	-	-
Total	100	100	100

As indicated earlier, the farmers in Karakambadi are not able to mobilise institutional finance to develop groundwater and cultivate more renumerative crops like sugarcane. On the other hand, the fanners in Kadirimangalam are well supported by the cooperative sugar-mill in its vicinity. It not only provides concessional finance for digging wells but also provides material inputs for sugarcane. Although the sugar cooperative is located within 20 km of Karakambadi, its operations have not extended to it so far. As a result only a few well-off farmers grown sugarcane in this village. The resource crunch in the first village is also reflected in the greater depth of the wells across the villages, which is a major constraint to growing water intensive crops like sugarcane. It can be observed from Table

3 that the depth of 66% of the wells is below 50 feet in Karakambadi, whereas in Kadirimangalam 42% of the wells fall into this category.

Table 3: Depth of Wells Across Village

Depth of Well (in feet)	% of wells in: Karakambadi	Kadirimangalam	Kondapeta
below 50	66	42	7
51 to 150	28	55	38
above 150	6	3	55

In contrast, the picture in Kondapeta is quite different from the other two villages. Kondapeta is situated on the branches of river Penna. Though it comes under K C Canal, command water never reaches as it is situated in the tailend of the canal. However, because of its location on the branches of river it has rich groundwater resources when compared to the other two villages in Chittoor district. Kondapeta is traditionally a betlevine growing village. This village is buzzing with betlevine operations throughout the year. The high profitability of the crop has resulted in cash flows throughout the year and the village is conspicuously affluent as a result. In this village, groundnut and other crops are grown in the lands which are not suitable for betlevine cultivation. The wells in this village are mostly greater than 150 feet deep (see Table 3). Although the high water requirement of betlevine, as reflected in the depth-to-watertable, the groundwater is still reliable.

GROUNDWATER MARKETING

From our discussions with old farmers, it appears that groundwater marketing is as old as well irrigation in these villages. Well irrigation is not a new phenomenon in this region. Most of the wells in the sample villages are inherited from generations and hence old. In most cases the present owners do not know the age of their well, though a number of farms are going for new wells, especially in Kadirimangalam in recent years. The only changes that have taken place in recent times are energisation and deepening of wells. The depth of the old wells has almost doubled during

the last 10-20 years indicating the depletion of water table consequent to energisation of wells. Except in Karakambadi, many of the wells in the other two villages are either bore-wells or in-well bores. In Kondapeta, a number of farmers have borewells on the river bed to facilitate uninterrupted water supply during summer. On the other hand, the very low adoption rates of rig technology in Karakambadi village can be attributed to capital constraints which are the consequence of their social and economic backwardness. Further, in this village only about 50% of wells have power connections and the rest use diesel pump sets. Whereas in the other two villages almost all the wells are equipped with electric motors. In the two villages in Chittoor district the horse power (HP) of the motors range from 3-5 HP, and in a few cases it is 7 HP, whereas in Kondapeta of Cuddapah district the HP ranges from 7-15 HP.

Selling and buying of water is a common phenomenon in these villages - at least for one season in normal years in the two villages of Chittoor district, while it is a round the year activity in Kondapeta of Cuddapah district. The magnitude of groundwater marketing in these villages is demonstrated in Table 4. It can be seen that more than 70% of the sample irrigated households are involved in groundwater marketing in one form or another. In order to understand various activities of groundwater marketing, we have grouped irrigated households into four categories, i.e. pure owners, joint owners, sellers and buyers. Pure owners are not involved in any kind of groundwater marketing activity. Joint owners are those who own the well or motor in partnership with one or more persons and sharing the water from the well. Joint ownership is observed in different forms. For instance, farmers become joint owners of the well by inheritance (through division of joint families). In this case farmers may have a jointly-owned motor, or separate motors. In some cases a well owner may join with a non-well owner to establish a motor on the well. In this case the well owner would be given preference in lifting the water. The other forms of groundwater marketing activities include water sellers and buyers. Water sellers are usually big farmers, while the buyers belong to the small farm size group who cannot afford to invest on a well. It can be observed from the table that marketing of groundwater takes place on a large-scale in all the villages. Even after taking out pure and joint owners, between 40-50% of the sample households in the villages are directly involved in water marketing.

Table 4: Distribution of Farmers by Groundwater Marketing Activities

Village	Pure owners	Joint owners	Sellers	Buyers	Total
Karakambadi	24 (30)	21 (26)	18 (22)	18 (22)	81 (100)
Kadirimangalam	26 (28)	18 (19)	20 (21)	30 (32)	94 (100)
Kondapeta	16 (19)	27 (32)	15 (17)	27 (32)	85 (100)
Total	66 (25)	66 (25)	53 (20)	76 (30)	261

* figures in brackets are % to the respective totals.

Water rates are charged on the basis of number of hours and horse power of the motor in all the villages and for all the crops, except in betlevine. For betlevine in Kondapeta a flat rate of Rs 20[3] per irrigation per acre is charged. This may be due to the high water demand of the crops which needs 4-6 irrigations per month throughout the year. Usually water buyers enter into an oral agreement with the sellers before they plant betlevine. In the case of other crops the charges are Rs I/hour per one HP motor. Kind payments, especially in the case of paddy, are also prevalent, usually 4 bags (76 kg each) of paddy are given as water charges for irrigating one acre of paddy. Though these rates are uniform for all the villages, the share of water charges in gross income of the crop vary from village to village depending on the yield rates as well as intensity of irrigation required.

[3] In 1991, 20 rupees = $US 1.

As the buying and selling activities take place at an informal level and by oral consent, we have not observed any problems between buyers and sellers. It is generally understood that sellers will provide water to a buyer only after fulfilling their own requirements. In the case of multiple buyers, the distribution of water, i.e. who gets the water first from the sellers well, is on the basis of 'first come, first served'. That is, the person who approaches the seller first will get priority in the regular distribution of the water and he will be the last person in the event of seller withdrawing water supply due to paucity of water. In fact, in some cases where the well yield is high the distribution system goes as far as 1 km and the distribution systems, either field channels or pipe line, are laid by the buyer at his own cost.

GROUNDWATER DEVELOPMENT: SOME ISSUES

The experience of these three villages provide us three different developmental scenarios and helps us to raise some issues in groundwater development. Of these three villages, Karakambadi, a traditionally poor and backward village and Kondapeta, a traditionally rich village, stand at extreme poles. In Kondapeta private capital, accumulated over generations, dominates groundwater development. As such it does not face any problems, either economic or ecological, of groundwater exploitation as it follows the pattern established over years, and it is very unlikely that they would deviate from this pattern. It appears that the groundwater potential and the cropping pattern, though highly water intensive, are perfectly matched for the time being in this village.

On the other hand, Karakambadi suffers from capital constraints and negligence at official level which may be attributed to their lower social as well as economic status. Though these farmers are aware of the benefits of sugarcane crop and the available rig technology, which would facilitate growing the crop, only a handful of them grow sugarcane. These are some of the big farmers of the village who can afford to go in for deeper wells with rig technology.

The experience of Kadirimangalam is more interesting and revealing. This village is in transitory stage of development. It is a typical model of many such villages in various fragile resource zones of the country which are suffering from the reckless policies of the government. The establishment of a cooperative sugar-mill in this region in the early 1980s helped farmers

to enjoy the benefits of this highly renumerative crop. Prior to this sugar factory their cropping pattern was dominated by paddy and groundnut. It was hardly ten years after they started growing sugarcane and enjoying the profits before they felt the pinch of depleting groundwater resources. Most of the farmers have either drilled bore-wells or in-well bores which are financed by the cooperative sugar factory. In recent years most of the wells are unable to supply the water for sugarcane. As a consequence of deepening of wells, some of the existing dug wells have gone dry and water selling for sugarcane has almost stopped. In fact, in 1986-87 on some plots sugarcane crop had withered away due to lack of water. This, in turn, prompted the farmers to go in for more and more deepening of wells and powerful motors, the latest being the submersible motors which cost around Rs 25 - 30,000. But this does not seem to be helping much. On the contrary, farmers are losing heavily. In fact, it was reported that in the summer of 1987-88 about Rs 10 million was spent in this village alone on new borewells with only 50% success rate (the cost of one well with submersible motor will be between Rs 50,000[4] - 75,000). It was also reported that some farmers got salt water when they drilled even deeper. After this the frustrated farmers started blaming the government for poor advice regarding the location of the wells. If the situation continues, the farmers may have to shift their cropping pattern, though they are not thinking of that option now.

Thus, natural resource planning needs more judicious planning and understanding of basic problems. Hasty and politically motivated decisions, like establishing sugar factories in low rainfall and water scarcity regions, prove detrimental rather than beneficial to the farming community in the long run. An appreciation of farmers' awareness and understanding of their resource structure is vital, and their involvement in the planning level would help in arriving at more appropriate policies. In this context, community participation of village community in solving their problems through institution of self-correcting mechanisms may be a viable proposition (Shah, 1990). But here the problem is that village communities at present are ill-equipped to organise themselves in order to solve their problems and hence, there is need for an outside organisation which can motivate and help the farmers in this regard.

As far as the problem of depletion of groundwater table in Kadirimangalam village is concerned two plausible solutions, at this juncture, can ameliorate

[4] In 1986, US$ 1 = 1 Rs.

the conditions. One is that groundwater recharging mechanisms like percolation tanks would enhance the availability of water (supply side adjustment). Another is shifting the cropping pattern towards less water intensive crops (demand side adjustment). It may be noted here, that contrary to the popular belief, there are crops like mulberry, grapes, citrus, etc, which are as renumerative as sugarcane and have lower water requirements, but they have marketing and/or processing requirements (Vincent, 1989)[5]. Moreover, some of these crops are suitably adopted to the conditions of these regions. Therefore, more concerted efforts are required on the part extension service department in order to educate farmers on various alternatives available for them within the given resource constraints. And, the role of non-governmental organisations (NGOs) in this regard would be vital.

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[5] *These crops also have high cultivation costs, and thus can only be grown by farmers with available capital, and the tenure security to produce tree crops. With good water supply, groundnuts, vegetables and fodder can be profitable (although at a lower level than fruit crops or sugarcane): they have lower cultivation costs and are less demanding on operational budgets. With unreliable irrigation, net returns are low on most crops, and fanners will not risk extensive use of inputs. Editor.*

GROUNDWATER DEVELOPMENT AND DEPLETION: PROSPECTS AND PROBLEMS IN A POCKET AREA OF BANGLADESH[1]

M S U Talukder, M Ahmed, and M A Mojid
The authors are Professor, Associate Professor and Lecturer, respectively, in Department of Irrigation and Water Management, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Bangladesh is mostly underlain by unconsolidated to poorly consolidated thick sediments. In addition, the tropical monsoon climate characterised by high temperature, heavy rainfall and often excessive humidity is very favourable for extensive development of groundwater resources in the country. Groundwater, a renewable natural resource, is observed in Bangladesh to be in dynamic equilibrium consistent with the extraction by natural and artificial means and recharge from rainfall, flood waters and surface water bodies. Different techniques and concepts for the development of groundwater are being practised without detailed investigation of the resources and its overall management policy. For example, the groundwater development programme using deep tubewells (DTWs) started in the country in late sixties. But tubewells were installed initially almost without evaluating the hydrogeologic characteristics and development potentialities of the local aquifers. There are important factors in determining the amount and cost of groundwater that can be developed and in forecasting the consequences of development.

The groundwater development programme in Bangladesh has been suffering due to various reasons, of which insufficient hydrogeological data, poor and widely variable estimates of potential recharge and improper matching of well numbers and types to the identified groundwater resources are all very important. Although many authors have called for better planning (Rust, 1983; Haque, 1984; Radosevich 1983), little attention has been given to the after-effects of heavy groundwater withdrawal and consequently many alarming situations have been anticipated (Khan, 1988). Often individual events are extrapolated without scientific foundation. For example, reactions began when in Bogra, Jamalpur, Pabna and Chittagong (four

[1] A full version of this paper, complete with hydrological data, is available from the authors.