Community Sprinkler System in Sullikere Village, Bangalore Urban District, South India

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ABSTRACT

DURING THE LAST three decades there has been a substantial increase in well irrigation in many parts of India. This has resulted in a sharp increase in groundwater draft, leading to a decline of water levels in many areas, particularly in the low-rainfall hard-rock (LR HR) areas, such as, the eastern dry zone (EDZ) in the southeastern parts of Karnataka State. Water level decline has depressed well yields and increased well failures, particularly in respect of borewells (BWs). This has also led to a steep increase in the cost of well construction, seriously affecting the viability of wells. As a result, many small and marginal farmers are denied access to well irrigation.

The above situation has prompted a group of 16 marginal farmers, owning a contiguous piece of 13 hectares (ha) of land in Sullikere Village of Bangalore District (Urban), to form a cooperative society (CS). The state government has given a grant to the CS for 3 BWs, 3 submersible pumpsets (SPs) and for installing a sprinkler system. The above farmers have been practicing community BW and sprinkler irrigation for the last two years, cultivating a judicious mix of perennial and field crops and deriving a steady flow of income.

INTRODUCTION

Sullikere Village in Bangalore Urban District is located in the EDZ which is one of the ten agro-climatic zones of Karnataka State (Figure 13.1). The EDZ is drought prone receiving an annual rainfall of 768 millimeters (mm) mostly during the southwest monsoon season (CGWB[48] 1987). It is an undulating terrain covered by red loamy soils.

The EDZ is occupied by hard rocks which lack primary porosity. Storage and transmission of groundwater in these aquifers take place through secondary porosity, caused by weathering and fracturing (Raju 1985). The weathered residuum extends to a depth of 5 to 10 meters (m) followed by a fractured zone, up to a 50 m depth (CGWB ibid). However, the occurrence of fractures below 50 m is also reported in a few areas.

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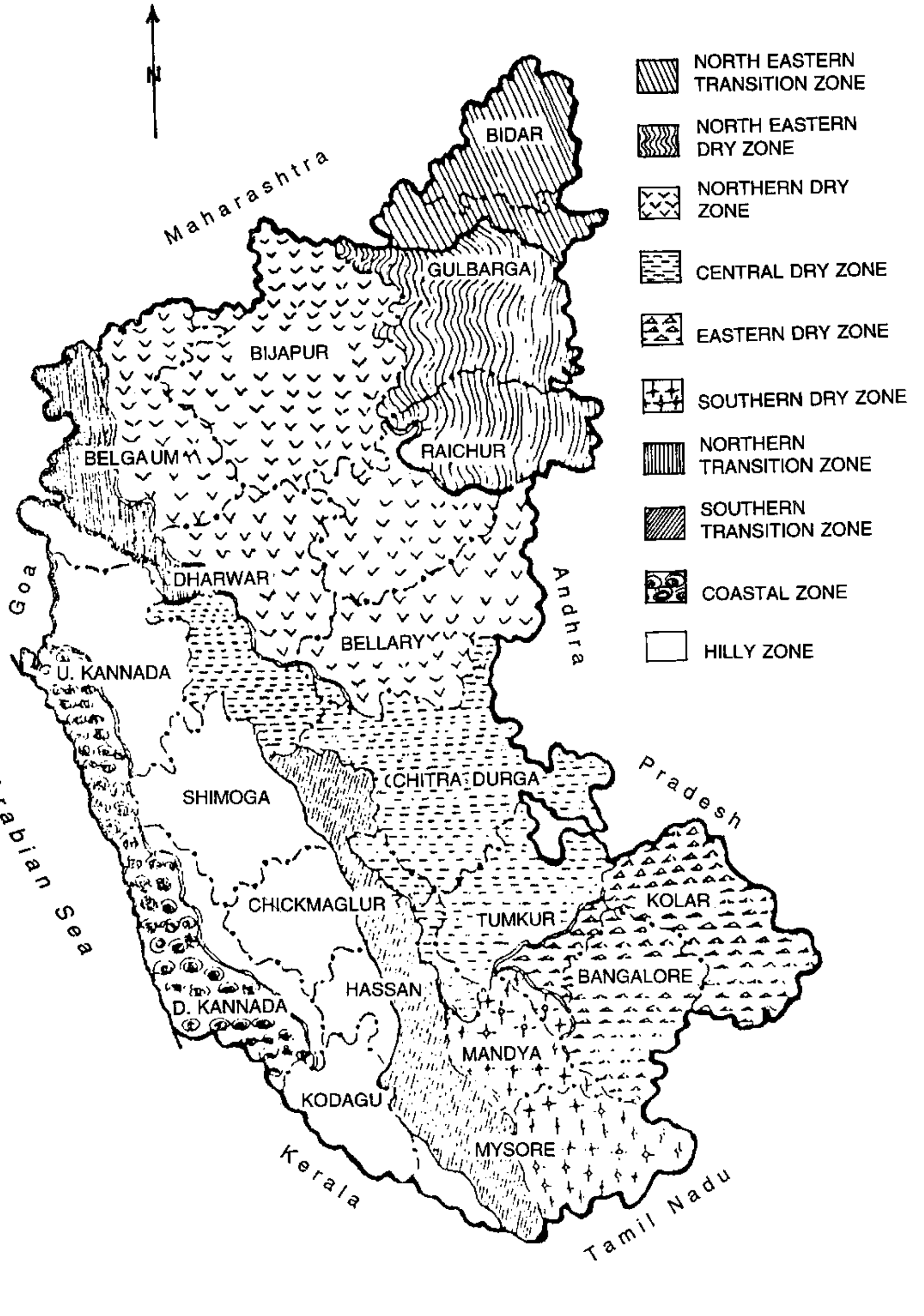
48 Central Ground Water Board (CGWB) is the apex organization in India for the exploration of groundwater.

Figure 13.1. The ten agroclimatic zones of Karnataka State.



EVOLUTION OF WELL STRUCTURES

Irrigation well structures in the study area of Sullikere Village, as in other parts of EDZ,[49] have undergone an interesting evolution during the last thirty years. The first phase which lasted till the early 1960s was dominated by large diameter (cross-sectional area up to $100m^2$) dugwells (DWs), rarely exceeding 10 m in depth. These wells were mostly operated by bullock power. Groundwater draft from these wells was extremely low (0.30 hectare-meters per year) and the low discharge realized could hardly irrigate 0.5 hectare (ha) of less irrigation intensive crops.

Sharp Increase in Pumpsets

The second phase of development was marked by centrifugal pumpsets, which became extremely popular because of their low cost, high efficiency and easy maintenance. Installation of a pumpset (diesel or electric) enhances the discharge and consequently the command area of a well by three to four times. Moreover, it became imperative to draw more water from wells, because during this period farmers switched over increasingly to high yielding varieties of seeds and heavy doses of chemical fertilizers which demand intense irrigation.

Even while well owners were switching over to pump irrigation, new wells were coming up simultaneously in increasing numbers. Various government sponsored programs subsidizing wells and pumpsets, and the easy availability of institutional credit gave a fillip to well construction (Rao 1991). There was more than a threefold increase in the number of wells in a span of two and a half decades, increasing from 135,000 in 1960/1961, to 490,000 in 1985/1986 (Figure 13.2).

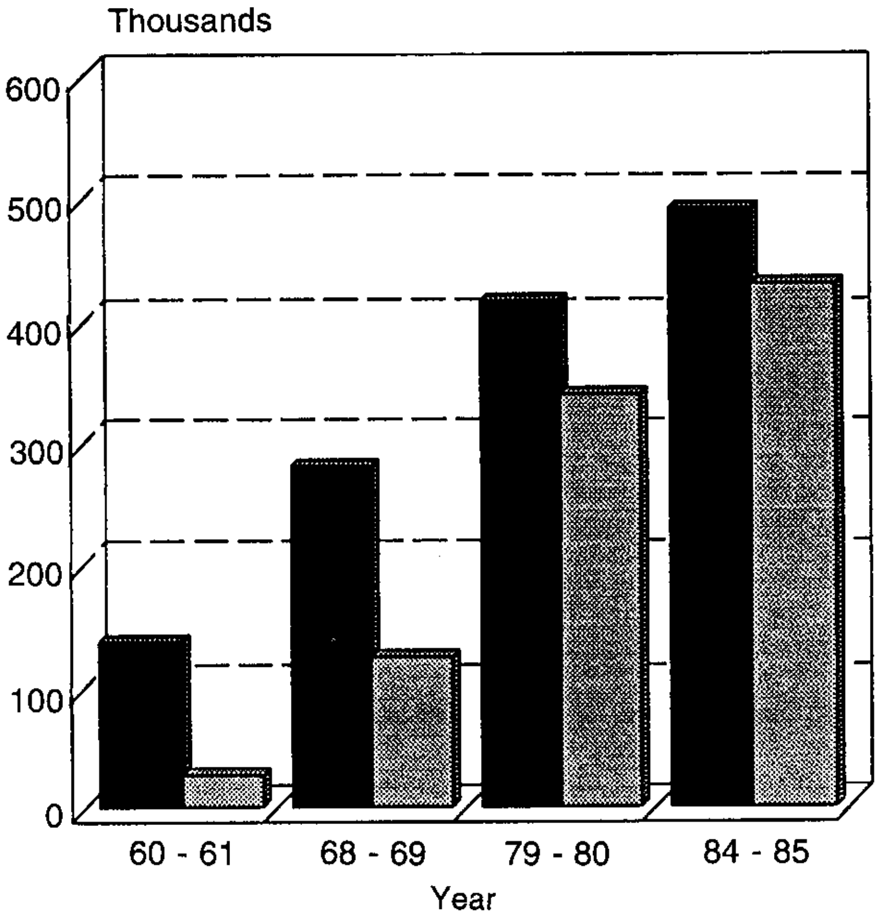
Construction of wells and installation of pumpsets were more vigorous in the EDZ. During 1990/1991, it had 12 percent of the net sown area of the state but accounted for 32 percent of the total agriculture pumpsets. This can be attributed to the heavy dependence of this area on well irrigation due to the lack of a good network of canals. Deterioration of tank irrigation also contributed to the spurt in well construction (Van Oppen et al. 1983)

Dug cum Borewells (DCBs)

The twin effect of large-scale pumpset installation and increasing number of new wells has been devastating on the groundwater levels, particularly in the LR HR areas, forcing the farmers to deepen the DWs periodically. Conversion of DW into DCB by drilling shallow bores to chase the declining water levels was attempted by many. However, it was soon realized that DCBs had limited use because in many areas water levels receded below the suction lift of the centrifugal pumpsets, rendering the well as well as the pumpset temporarily non-functional.

49 EDZ comprises all the blocks of Bangalore Urban, Bangalore Rural and Kolar Districts, besides two blocks of Tumkur District. As statistical data for parts of the district were not available, the entire Tumkur District is considered as part of EDZ in the present paper.

Figure 13.2. Increase in wells and pumpsets in Karnataka State.



Wells	135	280	415	490
Pumpsets	27	124	338	430

Borewells (BWs)

The third phase of development, marked by the introduction of BWs, commenced in the early-1980s. These small diameter (150 mm), deep structures (about 50 m in depth) could be constructed quickly (it takes about 12 hours to drill a borehole of 50 m depth as compared to months of excavation of a DW of much shallower depth), and they also dispensed with the problem of frequent deepening required for a DW. Moreover, due to thick saturated zone available a BW can be operated continuously. These factors encouraged farmers in the hard rock areas, particularly in the EDZ, to construct more BWs. In a short span of 5 years since 1982, borewells in the state increased fivefold. Increase in BWs is even more sharp in the EDZ (Table 13.1).

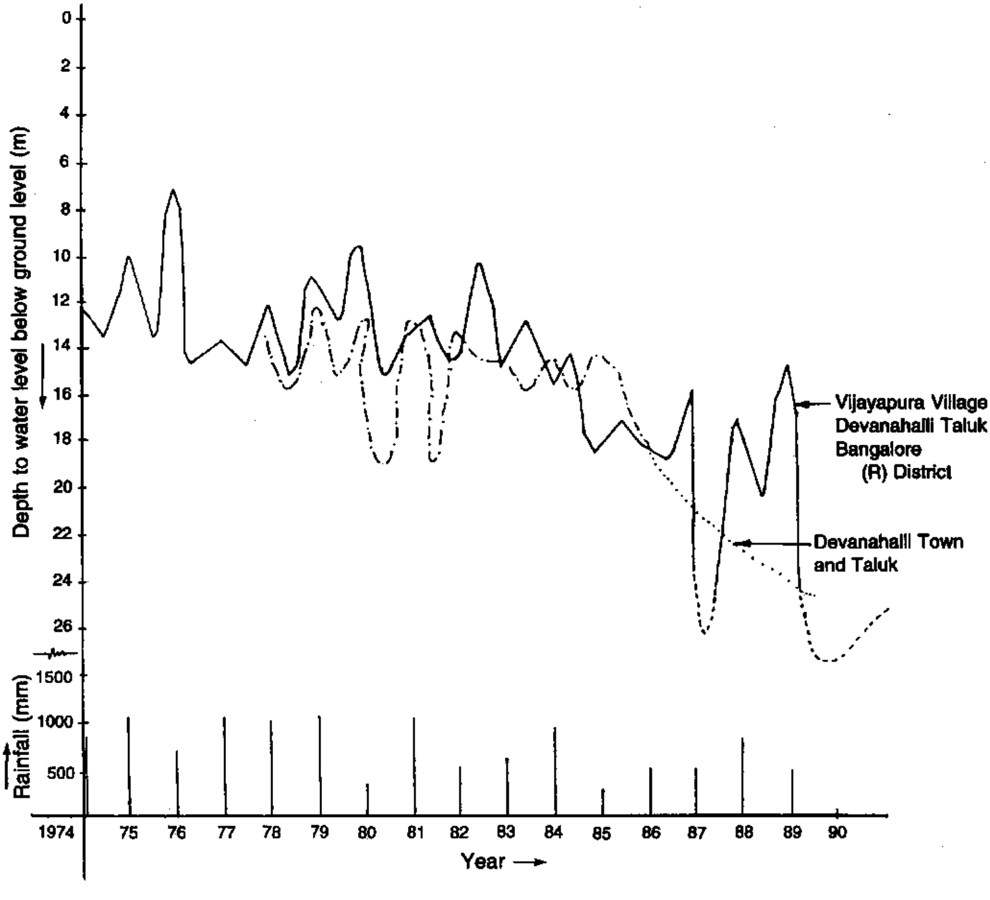
Table 13.1. Borewells in Karnataka State and eastern dry zone.

Zone	1982/1983	1983/1984	1984/1985	1985/1986	1986/1987
EDZ	3,328	5,786	9,862	15,176	19,077
Karnataka	7,855	12,935	21,136	32,385	40,923
Percentage of Karnataka borewells in EDZ	42.4%	44.7%	46.7%	46.9%	46.6%

Note: EDZ = Eastern dry zone.

Proliferation of BWs and their ability to yield more water resulted in the further decline of water levels, particularly in areas where the concentration of BWs is high (Figure 13.3).

Figure 13.3. Hydrogaphs of wells in the eastern dry zone, showing water level decline.



Energization Program and BWs

BW proliferation has a strong link with pumpset energization, because, unlike a DW, a BW cannot be operated without electric connection. The liberal energization policy of the SEB since 1980 has contributed greatly to the increase of BWs.

Failure of BWs

Though BWs have several advantages over DWs they suffer from the serious problem of a high failure rate. It is the experience of the state-owned Karnataka Agro-Industries Corporation (KAIC) (the nodal agency in the state for constructing BWs under government sponsored programs), that the average failure rate of BWs is 30 percent. As against this, failure in the EDZ, characterized by deep and declining water levels, is much higher, recording more than 50 percent in a few areas. In addition to high failures at construction stage BWs also suffer from declining yields as a result of fall in water levels, thus reducing the economic life of these structures drastically.

VIABILITY OF WELL IRRIGATION

Power is supplied to agriculture pumpsets in the state at Rs (Rupees) 50 (US$2) per horsepower (hp) per year. As against the above meager revenue, the SEB incurs a capital expenditure of Rs 15,000 (US$600) toward energization of a pumpset and recurring expenditure of Rs 6,400 (US$256) per year toward the cost of power supplied. If subsidy on power supply is withdrawn and the cost of BW failure is accounted, the viability of BWs is seriously eroded (see Annex).

Expansion of Well Commands

It may be seen from the above that there is a need for optimizing the benefits of well irrigation. It can be achieved by expanding the command area of a well by growing high value crops, preferably those which can be irrigated efficiently through water conservation methods, such as drip and sprinkler systems. The average discharge of a BW is 2 liters per second (lps). which can irrigate about 1.5 ha. The same BW can irrigate at least 20 percent additional area if the sprinkler system is introduced (increase in command area is even higher if it is undulatory land and/or occupied by light textured soils). By shifting the crop pattern in favor of widely spaced crops, such as mango or coconut and installing the drip system, as much as 10 ha can be covered by a BW. However, the main constraint in expanding well commands in this manner is the predominance of small landholdings. In Bangalore District, in which the present study area is located, 52 percent of the landholdings are less than 1 ha (Directorate of Economics and Statistics—DES—1990). A similar picture is reflected in most other districts of the state. Therefore, expansion of well commands is possible only if small groups of farmers learn to share a well and also the sprinkler/drip system installed on it. A rare example of such an idea in practice is evident in Sullikere Village in Bangalore (South) Block.[50]

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50 Block is a developmental unit comprising of a group of villages. A few blocks form a district.

COMMUNITY SPRINKLER SYSTEM (CSS) IN SULLIKERE VILLAGE

The state government, under a program of uplifting the economic condition of the rural landless, gave 13 ha of land free of cost to 16 scheduled caste[51] agricultural laborers of Sullikere Village. Ownership of land did not, however, improve their economic condition because of low productivity of the land due to lack of irrigation facilities. Income from one crop of ragi grown during the monsoon season under erratic rainfall conditions was grossly inadequate and the beneficiaries were forced to continue to work as laborers during the major part of the year.

The hydrogeology of Sullikere Village is suitable for groundwater development. Several government sponsored programs and institutional credit facilities were also available for construction of wells. However, the 16 farmers could not afford wells because the land owned by each of them was too small to support the investment of about Rs 50,000 (US$2,000) for a BW, pumpset, etc. Another limiting factor was the undulating lands, which when irrigated under conventional flow irrigation, resulted in poor efficiency.

Cooperative Effort

Looking into the plight of these farmers, Mr. Basavayya, the then Block Development Officer[52] (BDO) of Bangalore (South) Block, encouraged them to form a Cooperative Society (CS) and register[53] it with the state government so that they could derive the full benefit of the various developmental programs of the government.

Encouraged by the BDO, all the beneficiaries resolved to form a CS and practice community BW irrigation. Thus *Maruthi Harijana Neeravari Sahakara Sangha* (MHNSS) (Maruthi Scheduled Caste Irrigation Co-operative Society) was founded in the year 1986 with 50 members (the sixteen beneficiaries included all the major members of their families as MHNSS members). The by-laws of the co-operative were framed in the lines of lift irrigation societies (several formal societies and informal groups are operating successfully in the northern Karnataka districts of Bijapur and Belgaum and the neighboring Maharashtra State) for lifting river water for irrigation. The CS was registered with the Assistant Registrar, Bangalore (South) in June 1986. The salient points of the by-laws which were adopted by the CS are as follows:

i) Ownership of the land continues to be with the individual members.

ii) Members have the liberty to choose the cropping pattern.

iii) Uniform amount of water will be supplied to the members, irrespective of the size of the holding and the cropping pattern adopted.

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51 Socially and economically backward community, with several constitutional rights and privileges.

52 Middle-level state government executive charged with the responsibility of carrying out developmental work in a block.

53 Co-operative movement is widespread in India, particularly in the western and southern parts of the country. Movement of the people, for the people, and managed by the people for ensuring equal distribution of profits to all the members, is the basic concept of the co-operative movement. Any homogenous group of members (a minimum of ten) aspiring for a common cause can form a co-operative. The Co-operation Department of the state government registers the co-operatives and functions as their friend, philosopher and guide. In case of a dispute among the members, the state government acts as the arbitrator as well.

Soon after registration, the members elected ten promoters, who, in turn elected the President. A salaried secretary was appointed for correspondence and looking after the day to day functioning.

The president has completed primary schooling and is a natural leader who is capable of carrying all the members with him. He is also capable of interacting with government departments at various levels. He is the elected president since 1986 and informal discussions with the members revealed that they have no plans of replacing him.

The secretary is an employee of the local branch of a commercial bank. He has studied up to secondary school level and is capable of maintaining records and correspondence.

The nine elected promoters are in different age groups and take an active interest in the working of the co-operative. One of the promoters is a literate, middle-aged woman.

Technical Aspects of CSS, Sullikere

Action for Water Development (AFWD), an NGO with infrastructure for BW site selection and drilling, surveyed the project area in the year 1986. However, drilling of BWs was not undertaken immediately for want of funds. The beneficiaries did not have their own resources and were not eligible to receive bank loans because they had defaulted in the repayment of loans received earlier from banks. Finally, considering the socioeconomic status of the farmers, the SG granted funds for 3 BWs, 3 SPs and for the laying of sprinkler systems. Soon afterwards the AFWD drilled 3 BWs (in the year 1989/1990) which yielded 2.4 lps, 3.8 lps and 5 lps discharge (Figure 13.4). SPs of 6.5, 6.5 and 10 hp were installed on the three BWs.

Cropping Pattern

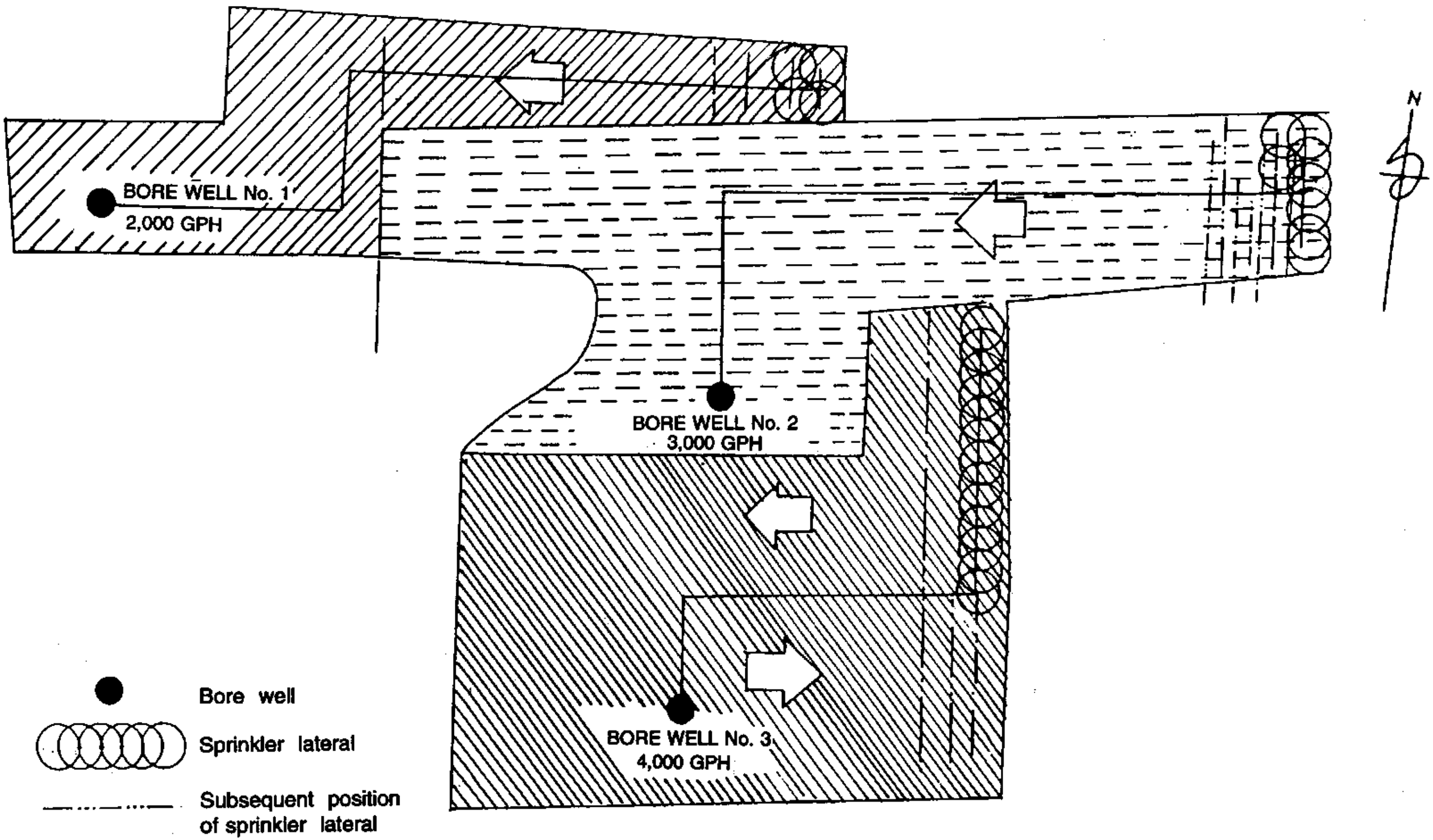
The beneficiaries had their own choice of the cropping pattern. The overall cropping pattern was, however, a judicious mixture of perennial and field crops (Table 13.2).

In view of the undulating nature of the topography it was necessary to install sprinklers without which the conveyance and application efficiency would have been low. Each BW has a definite command area depending upon its discharge. The design of the sprinkler system was based on the principle of applying 2.5 centimeter thick irrigation water, once in 8 days, by operating the system for 12 hours per day. The total discharge requirement for the above parameters worked out to 10.5 lps (90 percent efficiency) against the total available discharge of 11.20 lps. The sprinkler system was provided with aluminum pipes of 75 mm diameter and 1,800 m length for the main and lateral pipes. Altogether 21 sprinkler heads were provided with 12 m spacing.

Economics of the Scheme

Though Sullikere beneficiaries have received government grants for constructing BWs, installing pumpsets and a sprinkler system; the economics has been worked out assuming market rates for the above investments. It is observed that the scheme is thoroughly viable with the Internal Rate of Return (IRR) being more than 50 percent, when the subsidized rate for power consumption is considered. However, if subsidy on power consumption is removed, the IRR is 31 percent (It is further reduced to 23 percent if a 10 percent reduction in production is assumed).

Figure 13.4. Community sprinkler system in Sullikere Village, Bangalore (S) Block.



Note: GPH = Gallons per hour.

Table 13.2. Cropping pattern in community sprinkler system farm, Sullikere Village.

Perennial crops	*Kharif* (monsoon)	*Rabi* (winter)
Mulberry 3.2 ha Coconut 4.0 ha Mango 1.6 ha Banana 1.0 ha	Ragi 3.2 ha	Vegetables 3.2 ha

Management of the Scheme

Each farmer is provided water for 6 hours, once in 8 days. Shifting of the lateral pipes is the responsibility of the farmer who is going to use the sprinkler system. The CS collects only the electricity charges from the beneficiaries once a year. This amounts to a nominal sum of Rs 125 (US$5) per ha. Whenever there is a pump break down, farmers covered under the particular pump collect money to meet the cost of the repairs. No maintenance fund is built up and repairs are carried out through ad hoc collections.

MHNSS: SCOPE FOR IMPROVEMENT IN CSS FARM

Though BWs in the study area have good and sustainable yields, the available water falls short of demand in the peak requirement period, i.e., late rabi and summer seasons. It is necessary to construct at least one more BW to ensure an adequate supply of water during all the seasons.

Fencing may be erected to protect the farm from encroachment. For effective on-farm operations and haulage of agricultural produce to the market, a tractor may be added to the assets of the co-operative.

In view of the highly fluctuating voltage conditions, the SPs are bound to get burnt frequently. Quick repair to the pumpsets is essential, without which irrigation scheduling will be seriously disrupted. For efficient management of such crises, the co-operative may build up a maintenance fund by collecting at least Rs 250 (US$10) per ha annually from the farmers. The beneficiaries should also repay their bank loans which are presently outstanding. This will render them eligible for fresh loans and reduce their dependence on government grants for any expansion or strengthening of their farming activities.

Efforts must be made to conduct meetings of the promoters regularly, at least once a month. It is also observed that elections to the posts of promoters and president were never held after the initial elections. In accordance with the democratic norms of the co-operative, elections must be held once in three years, as stipulated by the by-laws.

CONCLUSION

The success of CSS at Sullikere could be attributed to the motivation of the BDO in forming the co-operative and to the strong leadership of the president. Realization of the members that unless they share the wells and the sprinklers, they can never have access to irrigation has strengthened the hands of the BDO and the president. Though CSS has come into existence only because of the liberal government grants, it is a fact that successful operation of this will have a positive demonstrative effect on the marginal farmers in the neighboring areas. Concerted efforts are necessary from the extension department of the government in educating marginal farmers about the various alternatives available to them within the given resource constraints. The role of NGOs in this regard would be vital.

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Annex

A. ECONOMICS OF BOREWELL IRRIGATION

		With subsidy (Rs)	Without subsidy (Rs)
I	Investment cost		
	Borewells	15,500.00	15,500.00
	Pumpsets	24,500.00	24,500.00
	Cost of failure	0.00	6,200.00
	Total	40,000.00	46,200.00
II	Maintenance cost		
	Cost of power consumed/year	250.00	6,400.00
	Maintenance of pumpset/year	800.00	800.00
III	Estimated net incremental income	15,900.00	15,900.00
IV	Estimated internal rate of return	> 50%	22%

B. ECONOMICS OF COMMUNITY SPRINKLER IRRIGATION AT SULLIKERE VILLAGE

		With subsidy (Rs)	Without subsidy (Rs)
I	Investment cost		
	Borewells (3 numbers)	54,000.00	54,000.00
	Pumpsets (3 numbers)	86,000.00	86,000.00
	Sprinkler system	1,87,000.00	1,87,000.00
	Total	3,27,000.00	3,27,000.00
II	Maintenance cost/year		
	Power	1,610.00	60,000.00
	Sprinkler maintenance	3,740.00	3,740.00
	Pumpset maintenance	2,400.00	2,400.00
	Total	7,750.00	66,140.00
III	Estimated net incremental income	1,44,900.00	1,44,900.00
IV	Estimated internal rate of return	> 50%	31%

Note: All rates in Indian Rupees.
US$1.00 = Rs 25.00.