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AFFORDABLE WATER SUPPLY AND SANITATION

Groundwater depletion due to agrowells

K.L.L. Premanath and Tissa Liyanapatabendi, Sri Lanka.

NATIONAL WATER SUPPLY & Drainage Board with financial and consultancy (COWIconsult) assistance from DANIDA carried out a study to prepare a Master Plan Report on water and sanitation needs of the Anuradhapura District during February 1992 to March 1993. Anuradhapura District is located in the dry zone of Sri Lanka having an average annual rainfall of about 1200mm. Main occupation of the people in the district is agriculture.

The ground water in Anuradhapura District is presently being used for both domestic and irrigation. Water for irrigation is pumped from agrowells. However, the recharge of groundwater from infiltrated rainwater sets the limits for how much water that can be extracted annually. There were 5720 agrowells constructed within the district by the end of year 1992. Out of these an estimated 2500 nos were private wells whereas the remaining wells have been constructed with government subsidies. A detailed study was carried out to monitor agrowells in the district with respect to the fluctuation of water levels and varieties in the chemical qualities.

Methodology used in the study of agrowells are (a) Field survey of agrowells collecting technical and agricultural data (b) Interviews with agricultural authorities and district administration (c) Establishment of a data base (d) Analysis of data.

179 nos of agrowells, covering the whole district were identified for monitoring purpose. Data collected from wells show that a typical agrowell is 6.4m deep, has a diameter of 5.4m and a mean water level 3.5m below ground level. Over the year the water level varies between 1.9m and 5.0m below ground level. It is constructed by the owner by hand / mechanical digging and is lined on the inside by cement blocks or bricks. Construction cost excluding own labour and pump has been about Rs. 29000.00. Pump capacities vary typically between $27m^3$ / hr and $45m^3$ / hr.

The government of Sri Lanka commissioned the agricultural development authority (ADA) through the Ministry of Agriculture Development and Research to implement a nationwide agrowell programme. Hence, the ADA started implementation of an agrowell programme in Anuradhapura District in 1989. Although the aim of the programme has been to assist farmers to cultivate crops at and around their homesteads and in highland areas where cultivation depends on rainwater, it is however now seen that farmers establish agrowells to support paddy cultivation in areas, where it is felt that gravity irrigation from the tanks needs supplementing.

In Anuradhapura district three different implementation modes are in existence. They are implementation of the nationwide programme supported by either ADA, the programme supported by the provincial council of the North Central Province, and there is a substantial number of agrowells being established privately without relation to the official programmes. The number of agrowells and the plans for further well construction at the end of the year 1992 are given in table 1.

It appears from above that a substantial number of agrowells have been already established. Further, all trends point in the direction of a considerable economic success for the programme and it must be assumed that wells may be established at a minimum, at the same rate as planned for 1993.

The beneficiaries of the programme are to a large extent the poor peasants who used to cultivate a single season (Maha) with rainwater and abandon the Yala cultivation due to inadequacy of irrigation water (Ariyabandu 1989). Even the maha crop was subjected to severe water shortage towards the end of the season. Today these farmers are benefitting from full cultivation seasons and in a few cases even a short third season between two major seasons. The cultivation comprises of cash crops such as chillies, Bombay onions, Red onions and vegetables as indicated by the field survey. Farmers with agrowells have increased their income substantially and in some cases up to ten times. Peasants who often had to migrate as labourers are now full time employed in their cultivation areas. Incomes in the range of Rs 20000.00 to Rs 40000.00 per season per acre have reportedly been generated.

The development of agrowells takes place in a rather haphazard way without a general assessment of the hydrogeological environment, the possible yield and a rational siting.

In order to assess the sustainability of agrowells and the possible conflicts with other water demands a rough evaluation of the irrigation water requirements was made based on the most common cultivation such as Chillies and Bombay onions. Water requirement from agrowell calculated on the basis of crop evapo-transpiration figures from development of agriculture and crop factors at various growth stages is given in table 2.

Sustainability of the system of lift irrigation using agrowells as the source depends on the recharging of the groundwater resource and the variations in recharge over the years. The recharge depends fully on the hydrological

Table 1. Present number of agro-wells constructed and planned (Ada, Anuradhapura district).

Year of construction	Agricultural development authority	Provincial council	Private (estimate)
Before 1990	100	159	
1990	159	238	
1991	919	340	
1992	1005	300	
Plans for 1993	1000	400	
Subtotal	3,183	1,437	2,500
TOTAL		7,120	

regime and the soil conditions. The recharge may differ from the highland areas to the valley bottoms, where the paddy cultivations are found.

Potential conflicts are many when there is an over-exploitation of the groundwater resource either on the local or on the regional scale taking place. Indiscriminate groundwater withdrawal will cause depletion of groundwater reservoirs. This will first be observed as a falling groundwater table, a perceived need to deepen the agrowells and a high frequency of wells running dry. The agrowells will interact and the deepest will deprive the other wells of water. Drinking water wells will likewise run dry and natural rivers and streams will suffer from extended dry spells.

Master Plan Study calculations show that for each acre irrigated there has to be 34 acres where recharge takes place in order to have a sustainable situation in highland areas. Similarly for low land areas corresponding area is 17 acres. The table 3 summarises the calculated recharge and the consequences in terms of maximum numbers of standard agrowells.

Under the assumption made,it appears that safe number of agrowells has been vastly exceeded as most development has taken place in the highland areas. It must be expected that serious depletion problems will occur and that agrowells will frequently run dry. They will affect each other in such a way that the deepest wells will make the other wells run dry. Further, nearly domestic water wells will also be drying up. There is thus an urgent need to bring the situation under control in order to avoid a situation like that in Tamil Nadu, where indiscriminate sinking of agrowells has caused a permanent depletion of the ground water resource. From the results of the data collected for the Master Plan, the figure 1 shows the decline in ground water level if present level of construction and use continues and if new construction of agrowells is stopped (Freeze).

Based on the very serious consequences that the continued pumping from the agrowells will have, the situation must be brought immediately under a tight control. Presently there is nothing to stop a farmer on private land from exploiting

the national groundwater resource at his will.

The following immediate steps are recommended.

- An urgent freeze of subsidies.
- An urgent programme of registration of the details of all agrowells, location, the irrigated area, pumping, etc.
- An urgent implementation of a ground water level monitoring programme in areas with clusters of agrowells.
- Immediate enforcement of criteria for distance between wells.
- Identification of legal framework for intervention in particular regarding privately constrcuted agrowells.
- Implementation of a regulatory system of water rights.
- Attaching responsibility for allocation of water rights to an independent agency which should also act as a supervising agency.
- Draw up standard construction details for agrowells that limits the rate of groundwater abstraction.
- Agricultural agencies should be instrumental in advising farmers on the optimal use of the water withdrawn and should collect information on the construction and use of agrowells.

Reference

Master plan for water supply and sanitation Anuradhapura district - June 1993.

Table 2. Water requirement from source (AGRO-WELL) for most common crop (figure in mm).

	MAHA	YALA
Crop water requirement A=ETxkc	703	916
B =Application Efficiency	55 %	55 %
C = Conveyance Efficiency	80 %	80 %
Water requirement at source D=A/B/C	1597	2082
R = rainfall	970	477
E = Rainfall Efficiency	70 %	70 %
Effective rainfall F=RxE	679	334
Water Requirement at source adjusted for effective rainfall W=D-F	918	1748

Table 3. Summary of recharge and "safe" number of wells assuming a cultivable highland area of 30,000 ha (75,000 acre) where agro-wells can be established and that agro-wells are desirable also within the presently irrigated lowland area.

	Highland (30,000 ha)	Lowland (irrigated are 110,000 ha)
Recharge	54	109
Required ratio between recharge area and irrigated area	34	17
Maximum no. of "standard" agro-wells (0.81 ha)	1090	7971
Present no. of "standard" agro-wells (0.81 ha)	7,120 (4,272 in highland and 2,848 in lowland)	

Figure 1. Decline in ground water level of construction and use continue and if new construction of agro-wells is stopped (freeze).