Groundwater in Andhra Pradesh, India: The case of privatization of a common

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Abstract

Andhra Pradesh is a south Indian state where groundwater plays an important role in agriculture. In Andhra Pradesh, around 45% of net irrigated area is from ground water. 15% of the total 1229 micro basins were classified as over-exploited in Andhra Pradesh. APWALT Act, the legislation to regulate groundwater in the state, was enacted in 2002. But, there is increasing evidence that the groundwater is being exploited as a private property in absence of clarity in policy and legislation in Andhra Pradesh. The existing legislations such as Andhra Pradesh Land Water and Trees Act (APWALTA) coupled with free electricity policy of the government accelerated the privatization of groundwater in Andhra Pradesh.

Present policies and legislations with strong focus on state control and regulation of ground water, missed the elements of community management of common property such as groundwater. Unregulated over-exploitation of groundwater resource continuing at rapid pace highlights the dismal status of growing gap between the policy and practice. Grass-root experiences, such as Social Regulation of groundwater, are promising and offering innovative and alternative solutions.

The paper discusses the groundwater situation in Andhra Pradesh and suggests to scale-up social regulations and sharing of groundwater experiences for ensuring equity and sustainability in both energy and water management. The paper also recommends strengthening and empowering local self governments (*gram panchayats*) and additional incentives to groups willing to share water by amending the APWALT Act.

Key words: *APWALTA, social regulation, groundwater, energy in agriculture*

1. Introduction:

Andhra Pradesh is a south Indian state with a total geographical area of 275,000 sq.km. The state is predominantly dependent on South-West monsoon during June to October with average annual rainfall of 925 mm. Rainfall varies from 495 to 1200 mm across state, with lowest reported in Anantapur district in Rayalaseema region and highest reported in Coastal region. *Rayalaseema* in the south and *Telangana* in the north are the two drought-prone regions with predominantly groundwater irrigation from private open wells and tube wells. The state has a net sown area of 10.84 m ha and net irrigated area of 4.4 m ha during 2005-06 (Directorate of Economics and Statistics, GoAP, 2006). Fig.1 gives area irrigated from different sources in Andhra Pradesh from 1955-56 to 2005-06.

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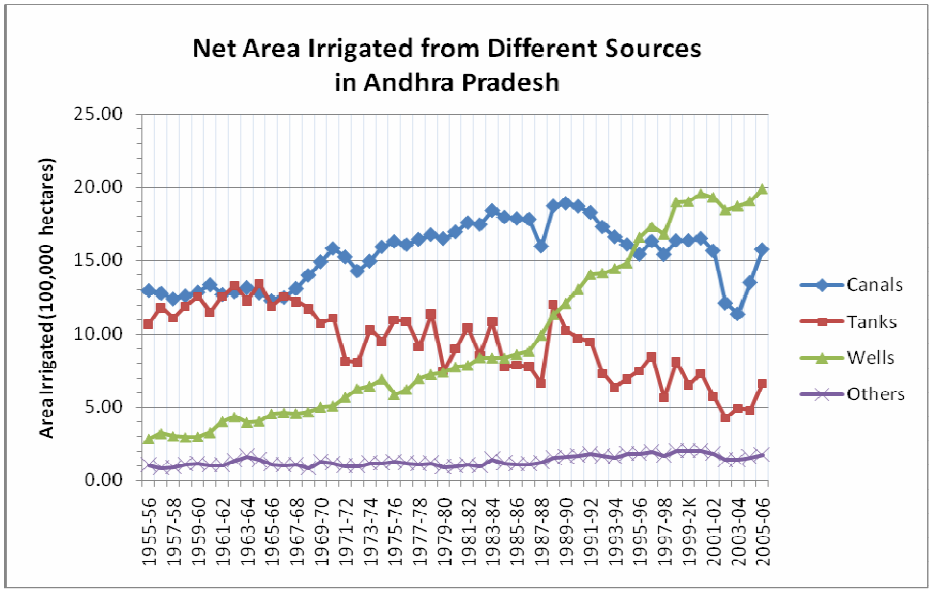

Fig.1: Net Area irrigated from Surface and Groundwater Sources in Andhra Pradesh (Directorate of Economics and Statistics, GoAP, 2006)

The net irrigated area from wells has been increasing (as per Fig.1) up to 1998-99, but later started to stagnate or grow at a slower pace till 2005-06. The net area irrigated by groundwater is about 45.23 % of total net area irrigated in 2005-06. The gross area irrigated by groundwater is reported to be 2.796 m ha out of 5.996 m ha of total gross area irrigated in Andhra Pradesh during 2005-06.

2. Classification of Micro-basins in Andhra Pradesh:

Andhra Pradesh has 23 districts with 1114 blocks and 28234 villages. During 2004, The Groundwater Department divided the state into 1229 micro basins, having an average area of 25,000 ha and classified them according to the stage of groundwater development. This classification was based on groundwater levels recorded from selected observation wells and secondary information available on the pumping intensities and cropping patterns in each micro basin.
As per their report, Groundwater Department classified 187 micro basins as over-exploited (groundwater development > 100%); 82 micro basins in critical condition (groundwater development > 90%); and another 203 micro basins as semi-critical (groundwater development > 70%) out of the total 1229 micro basins in Andhra Pradesh as shown in Fig. 2.

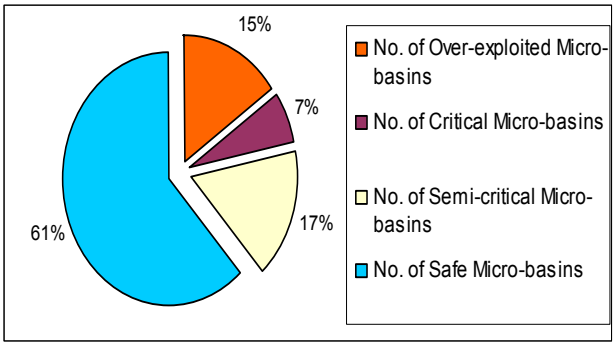

Fig.2: Classification of micro-basins in Andhra Pradesh (Groundwater Department, GoAP, 2006)

Groundwater levels declined by 2.5 m, on average, during the period 1998-2003 in Andhra Pradesh (Department of Disaster Management, GoAP. 2003). Obviously, this decline could be much more in over-exploited and critical basins.

3. Trends in Groundwater Irrigation between 1993-04 and 2000-01:

The over-all increase in gross and net irrigated areas under groundwater (as per Fig.1) is only a macro picture and does not reveal the variations in micro trends across the state. While area irrigated by dug wells has been decreasing, the area irrigated by shallow and deep tube wells has increased rapidly over last decade. In over-exploited and critical areas, due to exponential increase in well density, the yield and area irrigated per well has been reducing. Table 1 below reveals temporal variations in number and net area irrigated under different types of wells.

Table 1: Number of wells in Andhra Pradesh between 1993-94 & 2000-01

Type of well	1993-94		Gross Area irrigated (ha)	2000-2001		Gross Area irrigated (ha)
	Total	In Use		Total	In Use	
Dug wells	1216412	1018370	1245166	1185216	946393	1040644
Shallow tube wells *(Less than 70 m deep)*	317197	304358	617978	656359	637003	1010388
Deep tube wells *(More than 70 m deep)*	31216	29839	121969	87482	85601	242505
Total	**1564825**	**1352567**	**1985113**	**1929057**	**1668997**	**2293537**

(Ministry of Water Resources, GoI, 1993-94 and Ministry of Water Resources, GoI, 2000-01)

Above table reveals those numbers of total and used dug wells have been reducing with corresponding reduction in gross area irrigated. Shallow tube wells more than doubled between 1993-94 and 2000-01, but the gross area irrigated increased only by 63%. Deep tube wells increased by three times and correspondingly area irrigated doubled.

Area irrigated per well has reduced from 1.22 to 1.09 ha; from 2.03 to 1.59 ha; and 4.09 to 2.83 ha respectively from dug wells, shall tube wells and deep tube wells. The reduction in area irrigated per well is significant in shallow and deep tube wells. While these are average values taken across over-exploited; critical; semi-critical and safe areas, it is obvious that these values will be on higher side when calculated for over-exploited or critical area categories separately.

Further, following data given in Table 2 indicate alarming increase in number of wells with less water discharge, among shallow and deep tube wells, between 1993-94 and 2000-01.

Table 2: Status of Wells in 1993-94 and 2000-01

Type of well	1993-94		2000-01		% change in wells discharging less water
	Wells In Use	Wells with Less Water Discharge	Wells In Use	Wells with Less Water Discharge	
Open wells	1018370	440016	946393	376303	-14.5
Shallow Tube wells	304358	68204	637003	177967	+160.9
Deep Tube wells	29839	8020	85601	34216	+326.6
Total	1352567	516240	1668997	588486	+13.99

(Ministry of Water Resources, GoI, 1993-94 and Ministry of Water Resources, GoI, 2000-01)

Reduction in number of dug wells and wells discharging less water is due to further slippage of wells as dry wells over this period. Most of those shallow and deep tube wells that are discharging less might be located in over-exploited; critical and semi-critical areas in that order.

4. Role of energy in groundwater management:

Total installed capacity of electricity generation in Andhra Pradesh is 12330.12 MW (as on 31st January 2008) with 26,027 MU of cumulative energy generation. Maximum electricity consumption takes place during post-monsoon period when agricultural consumption peaks, touching as high as 200 MU per day.

Most of the wells in Andhra Pradesh are energized with electricity supplied free of cost and for about 7 hours per day. As per the reports of Central Electricity Authority, consumption of electricity for agriculture has reached 14,160 Giga Watt hour during 2004-05 in Andhra Pradesh which is about 36% of total electricity consumption in the State.

The Central Power Distribution Company, one of the four electricity distribution companies in Andhra Pradesh, reported an increase of 33% in demand for agriculture between 2003-04 and 2006-07 (CPDCL, Andhra Pradesh, 2008-09). Purchasing power from other sources and States contributing to the huge revenue deficit to the company. The company projected a revenue deficit of Rs.1150.3 crores for the year 2008-2009. Following Table 3 gives number of agricultural service connections in the state and increase of connections in 2007-08. The table reveals that there is an increase around 50,000 connections per year, on average, some are due addition of new wells and some from regularization of un-authorized connections.

Table 3: Status of Agricultural Service Connections in 2007-08

Agricultural Services	As on 31.03.2007	2007-08 (upto Jan 2008)	As on 31.01.2008
Distribution Companies (DISCOMs)	2439632	48844	2488476
Rural Electricity Service Corporations (RESCOs)	88168	1578	89746
Total	2527800	50422	2578222

(APTRANSCO, 2008)

In many areas, distribution transformers are over-loaded due to increasing wells; unauthorized connections; use of non-standard motors and use of higher capacity pump-sets. Low voltages at pump-sets are affecting the discharge and the life of pump-sets. This low energy efficiency in transmission and at the pump-set level is also a major contributing factor to the slippage of wells to less discharge condition and further to dry condition.

Field study on status of energy use in agriculture:

A rapid study of 2 distribution transformers (DTR) in 2 villages was carried out during October 2007 to February 2008 to understand the electricity supply status; quality of supply; load conditions on the DTRs; and pumping efficiencies. Measurements, such as voltage, current, discharge etc., were taken at 8-10 sample wells under each DTR. It was found that the DTRs are over-loaded by 30-44% due to 25% of un-authorized connections and use of few higher than sanctioned capacity motors.

Following table 4 presents the data from the field observations:

Table 4: Measurements of various electricity and water parameters

Village	No. of pump-sets / wells studied	Voltage (v)	Power Factor	Discharge (lps)	Hydraulic Efficiency (%)
Mylaram, Medak district	7 bore wells	250 to 379	0.53 to 0.97	3.31 to 7.68	59 to 83.8[1]
	3 open wells	200 to 318	0.78 to 0.84	6.56 to 13.72	68[2]
Enebavi, Warangal district	5 bore wells	255 to 326	0.54 to 0.82	1.84 to 4.94	41 to 52[3]
	3 open wells	245 to 326	0.73 to 0.81	4.66 to 5.03	38.5[4]

(Primary data from field study)

1-data from 4 wells; 2-data from 1 well, 3-data from 3 wells, 4-data from 1 well

Actual voltages measured at the pump-sets are as high as 40% lower than the standard voltage of 415 V recommended at the pump-sets. Correspondingly, consumption of current and power were recorded higher than the normal resulting in

wastage of power and affecting the life of motor. All these factors are contributing to the very low hydraulic efficiencies of pump-sets.

All the above analysis helps to infer that any further increase in number of wells will only contribute to over-loading on existing electricity distribution network; increase in well density; reduction of discharges; further drying of wells; reduction of area irrigated per well; loss of investments to farmers; and increase in electricity consumption; and increased Transmission & Distribution losses in energy transmission.

There is a need to explore ways of expanding area irrigated and increase the access to groundwater to small and marginal farmers, yet ensuring efficient and sustainable use of water and energy. It is in this context, the alternative approach of social regulations in groundwater management described in Section 6 deserves attention and deeper study.

5. Policy and Regulatory Framework in Andhra Pradesh

Repeated droughts and alarming depletion in groundwater resources during the late 1990s prompted the AP State Government to lay emphasis on efficient water conservation and management. The last decade has witnessed promulgation of various acts and guidelines related to water management. One such measure is the enactment called Andhra Pradesh Water, Land and Trees Act (APWALTA) in 2002. This Act repealed earlier legislations such as Andhra Pradesh Ground Water Act (Regulation for drinking water purposes), 1996 and Andhra Pradesh Water, Land and Tree Ordinance, no.15 of 2000. Table 5 gives the chronology of events in water-related policy evolution in Andhra Pradesh.

Table 5: Key events in water policy evolution in Andhra Pradesh

1996	Enactment of Andhra Pradesh Ground Water Act (Regulation for drinking water purposes)
1997	Enactment of Andhra Pradesh Farmers' Management of Irrigation Systems Act to promote participatory management of irrigation systems in the state
1999	Spelt out Vision 2020, emphasizing the importance of water management and participatory approaches to irrigation management for sustainable growth in the agriculture and fisheries sectors
2000	Andhra Pradesh Water, Land and Tree Ordinance (no.15)
2002	Enactment of Andhra Pradesh Water, Land and Trees Act (APWALTA)
2002	Release of Guidelines for Watershed Development in Andhra Pradesh based on the national guidelines (1994) and recommendations of the reviews done time to time during later years
2003	Andhra Pradesh Water Vision defining a broad policy framework for water management in the state

The APWALTA, enacted on 19th April, 2002 by Act no.10, is a comprehensive act covering surface and groundwater resources. The act aims to promote water conservation, enhance tree cover, and regulate the exploitation and use of ground and surface water. The act empowered the State Government to appoint a state

level authority, namely, Andhra Pradesh Water, Land and Trees Authority. The Authority has the mandate to promote water conservation, enhance tree cover, regulate exploitation of ground and surface water, make regulations for the functioning of the authorities at District and *Mandal* level (administrative units within Districts), and advice the Government on various legislative, administrative and economic measures and for the strengthening of public participation.

Various provisions under the Act are broadly categorized under the following four headlines (Government of Andhra Pradesh, 2002 & 2004):

- Groundwater protection measures
- Surface water protection measures
- Trees
- Miscellaneous, including penalties

Provisions related to groundwater listed under 'Groundwater protection measures' are quoted below:

- All groundwater resources in the State shall be regulated by the Authority
- Owners of all wells and water bodies shall register their wells / water bodies with the Authority
- Prohibition of water pumping in any particular area in the State
- Prohibition of and penalty for drilling new bore wells in any particular area in the State
- Any person shall obtain permission for drilling a new bore well (other than drinking purposes) within 250 m of a public drinking water source
- Declaration of over-exploited areas and ban on sinking new wells in these areas (other than drinking purpose). Periodic review of status and provision to revoke the declaration
- Protection of drinking water sources by prohibiting extraction of groundwater from existing wells in the vicinity that are adversely affecting the drinking water source. Compensation to the owner for closure of existing well
- Prohibition of water extraction for sale from an over-exploited water source or aquifer or residential areas or premises of multi-storied buildings in urban areas
- Specification of well spacing and depth for sinking new wells to curb unhealthy competition to tap water from deeper layers of groundwater
- Registration of drilling rigs by rig owners
- Issue guidelines and impose conditions for rainwater harvesting measures in residential, commercial and other premises and open spaces to improve groundwater resources
- Formulate guidelines for recycling and reuse of waste water by industrial, commercial users and local bodies
- Prohibition of groundwater contamination from any source, including industrial, domestic and aquaculture/agriculture
- Regulate sand mining to prevent depletion of groundwater and protect public drinking water supply sources

Specific rules and procedures were issued time to time through Government Orders on the above broad provisions in the Act. APWALTA rules and procedures were

revised comprehensively and a single-window approach was introduced in 2004. As per this system, a farmer can submit an application to get a permission to drill a new well to a single office (the *Mandal* Revenue Office) and the decision would be announced within 15 days.

The State Government came up with a notification in February 2005 listing 4003 over-exploited villages (15%) out of the total 26,586 villages and banned further exploitation of groundwater and sand mining in these villages. Table 6 gives the region-wise classification of these villages in Andhra Pradesh. That implies no new permissions to drill bore wells will be entertained from these villages. It was also stated in the notification that, the status of groundwater exploitation in these villages will be reviewed every six months and necessary modifications done.

Table 6: Number of villages notified as over-exploited in Andhra Pradesh

Region in Andhra Pradesh	No. of *mandals* covered by notified villages	No. of notified villages
Coastal	64	395
Rayalaseema	169	1378
Telangana	232	2230
Total	465	4003

(Government of Andhra Pradesh, 2004)

The Government of Andhra Pradesh introduced well failure insurance scheme for the bore well owners in March 2005. As per this provision, farmers who take permission from the concerned authority and drill a bore well, are eligible to claim the insurance subjected to a maximum limit of Rs.10,000 in case the well turns out to be dry. Farmers were required to pay Rs.1,200 towards insurance premium, in addition to the geological survey charges of Rs.1,000 (Rs.500 for small and marginal farmers) towards the cost of site investigation by a qualified hydro-geologist.

In June 2005, the State Government through a notification defined the minimum spacing to be maintained from existing drinking and irrigation wells, while according permission to new wells. Minimum spacing to be maintained in case of shallow tube wells is 260 m from an existing irrigation well and 250 m from an existing drinking water well. As per this rule, a farmer who sought permission for drilling a new well will not be allowed to do so, if its proposed location is within the specified minimum distance.

From 2006-2007, the Government decided to revise the insurance scheme for failed bore wells through the Commissioner, Rural Development by maintaining a corpus fund instead of being tied up with insurance companies. All those bore wells which were drilled after obtaining necessary permissions under APWALTA are eligible for insurance compensation of Rs.10,000 or actual expenses, whichever is less. In the new system, the farmers need not pay any premium for obtaining the insurance cover (Government of Andhra Pradesh, 2006).

Free power to agricultural pump-sets was introduced by the new State Government during late 2005, to replace the previous tariff system based on the horsepower of the pump. Though free power was supplied to farmers, the Government has been

limiting the number of hours of power supply from 9 hours to 6-7 hours a day due to shortage of power, especially during *Rabi* crop season (the dry season, from November to February). Still the free power scheme was a major trigger for the steep increase in number of energized bore wells (data given in Table 3) and deepened the power crisis during *Rabi* and summer months. Hence, there is a direct conflict between the policy promoted by the APWLTA and the power supply policy in terms of incentives for the farmers to exploit groundwater.

6. Implementation Experience of APWALTA

APWALTA has been in force since 2002. Significant changes in the operations of the Act came about in 2004, such as, introduction of single-window system. Later, during 2005, insurance of failed bore wells was another laudable measure to protect the farmers from huge losses. An analysis of progress achieved by APWALTA during 2002-2006 in terms of registration of wells and permissions for new wells is presented below.

Since inception in April 2002 to January 2006, a total of 2.2 million existing wells and 2,178 drilling rigs were registered under the Act. Permission was granted to dig a total of 5,389 new wells till January 2006. Table 7 compares this data with the data for the period January 2005 to January 2006, a one year period after the introduction of comprehensive single-window system.

Table 7: Achievements of APWALTA

	Apr. 2002 - Jan 2006	Jan 2005-Jan 2006
Existing wells registered	2.2 million	0.7 million
Drilling rigs registered	2,178	284
New bore wells given permission	5,389	2,500

(Ministry of Rural Development, GoAP, 2006)

The number of wells reported to be drilled legally during 2005-2006 (2,500) is much less than the average annual increase of 60,000 in number of wells in Andhra Pradesh during 1993-2001 given by the Minor Irrigation Census, Ministry of Water Resources, Government of India (Table 1). In contrast to this, the number of individual agricultural electrical service connections increased by 66,458 during 2005-2006 as per the statistics revealed by Andhra Pradesh Transmission Corporation (APTRANSCO), the state-owned company that deals with the electricity transmission in Andhra Pradesh. Comparison of these statistics from different sources gives the indication that the majority of new wells in Andhra Pradesh were drilled without obtaining permission from APWALTA authorities. In other words, APWALTA failed to check the indiscriminate proliferation of new wells in the state.

Following are the major observations on the APWALTA implementation experience:

- The Act was successful in registering most existing wells (2.2 million compared to 2.4 million electrical connections in Jan. 2006 and Mar. 2006, respectively). However, the disincentive provided by the penalty fees for drilling of illegal wells did not check the growth in numbers of new wells

- APWALTA primarily aims to regulate and control the drilling of new bore wells in already water-stressed areas either by banning new bore wells or by laying out the procedures for obtaining permissions. Data from different sources on average increase of wells in Andhra Pradesh indicate that the illegal drilling of wells was hardly controlled
- The community or the local *gram panchayat* has no recognized role in water governance, at local or regional level. People are mainly revenue generators for the state by paying registration charges for bore wells and drilling rigs, permission fees for new wells and penalties for violating the law
- APWALTA does not promote constructive steps or incentives towards conserving water, or using water more efficiently nor offers any disincentive for unlimited extraction of groundwater. Thus, APWALTA is not an "enabling law" that provides incentives for not going for a new bore well and encourages farmers to save and use groundwater efficiently.
- While existing bore well owners continue to exploit groundwater, farmers who do not have bore wells are denied opportunity to access groundwater within a specified distance from the existing drinking and irrigation wells. This Act does not provide "constructive measures" that help disadvantaged farmers also gain access to their rightful share in groundwater resources and associated livelihood benefits.
- APWALTA "empowers" the administration to control, regulate and manage groundwater with extensive and extra-ordinary provisions. One such provision is the power to regulate or limit the extraction from any well that is detrimental to the public interest. But, in implementation, the Act was reduced to a mere instrument that laid out procedures for obtaining permission for drilling new bore wells. Progress reports of authorities only highlight number of sanctions given and revenue generated in terms of fees and penalties. The Act does not propose any reforms in entitlements, such as altering the easement rights; defining entitlements of individual farmers or spell out sensible electricity tariff strategies to control groundwater use
- There is a perceptible gap in keeping track of happenings on the ground after giving sanctions to new bore wells and systematic reporting of progress achieved.
- APWALTA provides for transfer of 90% of the revenue generated from penalties for illegal drilling of wells to the respective *gram panchayats* to take up awareness generation activities on the provisions of the Act. But, this aspect could not be studied in detail as there is no explicit mention about this in any of the reports or data from APWALTA authorities.

7. Alternative approach of Social Regulation of Groundwater (Rama Mohan, 2007):

An action research project called "Social regulation of groundwater management at community level" was initiated in 2004 in three villages in Andhra Pradesh by the non-governmental organization Centre for World Solidarity (CWS), Secunderabad, Andhra Pradesh in partnership with local grass-root NGO – RIDS, Jana Jagriti, Nava Jyothi and CROPS. The project covers 715 families in 4 villages in 3 districts of Andhra Pradesh. The project aims to promote local regulation and management of groundwater resources with equitable access to all families in the communities. The project cost was around Rs. 2.5 million per year, over the last 3 years.

The four project villages, Madirepally (Anantapur district), Mylaram (Medak district), CR Pally (Anantapur district) and Enabavi (Warangal district) are in the semi-arid regions Rayalaseema and Telangana of Andhra Pradesh with repeated occurrence of drought. In all four villages, rain-fed agriculture is the norm, but groundwater is an important contributor to irrigation on 6-35 % of the land. Erratic rainfall and recurring drought conditions prompted farmers to use groundwater, which is more reliable and controllable. Groundwater provided the much needed life-saving irrigation during prolonged dry spells during the rainy season.

Initially, open wells were dug and electrical centrifugal pumps were used to extract groundwater. Farmers started drilling bore wells from the early 1990s and shallow open wells gradually dried up due to falling groundwater levels. Over the last 15 years, the number of bore wells grew rapidly in these villages. Due to indiscriminate drilling of bore wells and unscientific groundwater exploration, many bore wells failed either at the time of drilling or during later years. Furthermore, drilling bore wells as deep as 300 ft resulted in drying of shallower open and bore wells. This phenomenon resulted in huge loss of investments to farmers and seriously affected the livelihoods of farmers dependent on irrigated farming.

The project interventions began with a participatory assessment of the water resources status in the four villages. Participatory Rural Appraisal (PRA) methods were used to map the resource status and existing water utilization pattern for different purposes, such as: drinking, domestic, irrigation. Growth of groundwater-based irrigation and trends in groundwater levels over a period of time were thoroughly discussed and analysed in community level meetings, wherein women and men from all households participated. Series of such meetings and interactions helped to arrive at the crux of the issues, i.e., frequent failure of bore wells and increasing debts of farmers due to investment on new bore wells.

The competition between neighbouring farmers often leads them to drill bore wells as close as 2 m apart. For instance, in Madirepally village, three neighbouring farmers dug 13 bore wells in an area of 0.5 acres over a period of four years in competition to tap groundwater (see Fig.3 & 4). The project realized that there is need for changing the mind-set of farmers from “competition” to “cooperation” and to increase the “water literacy” among the farmers for efficient use of water.

Fig.3: Bore wells drilled in competition (before the project intervention)

Fig.4: Group of farmers sharing water (after the project intervention)

A number of training programs, exposure visits and awareness raising meetings were organized by the grass-root partner NGO and supported by CWS in the project villages. Further public awareness and education was carried out through posters, pamphlets and wall-writings. Participatory hydrological monitoring of rainfall and groundwater levels in selected bore wells was done regularly and shared and discussed at village meetings to increase the understanding of farmers on the behaviour of groundwater in relation to rainfall. A volunteer from the community measured rainfall from a simple manual rain gauge station installed in the villages and recorded the static water levels in 10 sample bore wells using an electronic water level indicator (see Fig.5). This data was displayed on a village notice board and updated periodically.

Fig.5: Participatory monitoring of groundwater levels

The last 3 years of intensive grass-root work and facilitation has resulted in the community realizing the ill-effects of indiscriminate drilling of bore wells and use of groundwater. The community evolved and agreed on the following 'social regulations' and interventions in the village:

- No new bore wells to be drilled in the village
- Equitable access to groundwater to all the families through well sharing
- Increasing the groundwater resources by conservation and recharge
- Efficient use of irrigation water through demand-side management (see Fig.6)

Small groups of farmers were formed in all the project villages between a bore well owner and 2 or 3 neighbouring farmers who did not own bore wells. Bore well owners were motivated to share by explaining that drilling new wells in the vicinity of their wells may render them dry due to competitive extraction of groundwater. Instead, sharing a portion of water from his well helps his neighbours and at the same time secures his access to water and thus livelihood. Sharing water with their neighbours will be a "win-win" situation benefiting both the bore well owners and water receivers.

Fig.6: Sprinkler system in use for irrigating groundnut crop

Small farmers were given priority in formation of groups. Table 8 below gives the number of such sharing groups in each village. Group members were encouraged to save water by using micro-irrigation kits (sprinklers) and share water from the existing wells rather than drilling new bore wells in the vicinity of existing ones. The project linked up with the existing 50% subsidy on micro-irrigation systems from the government scheme and offered additional subsidy of 20% to the groups to encourage sharing practice.

Surface water harvesting and retaining structures were renovated, and existing dry open wells were converted into recharge wells. Regular monitoring and recording of hydrological information, such as rainfall, water levels in 10 sample wells and water storage in all surface water bodies was done since 2004. Groundwater draft (also called extraction) for different purposes, such as irrigation, drinking and domestic was calculated based on the data collected from the villages.

Table 8: Water sharing in the three project villages as of 31st March 2008

	Madirepally	Mylaram	CR Pally	Enabavi
No. of functional bore wells	64	60	34	22
No. of bore wells under sharing system	64	39	34	5
No. of farmers sharing the water	135	107	56	15

* The project was initiated in Enabavi village from Jan 2007 only. Hence, only few wells are shared so far

While creating access to groundwater to around 182 farmers who do not own bore wells, the project was successful in reducing the groundwater extraction in the project villages. The project aimed at bringing all functional bore wells in four villages under the water sharing system by 2008.

8. Observations and Recommendations

The above analysis of groundwater situation in Andhra Pradesh gives the broader scenario in terms of use, management and regulations. Following major observations can be drawn from the above analysis:

- Exponential growth of wells in the state resulted in decline in groundwater levels and area irrigated per well
- The net irrigated area by groundwater increased until 2000 but remained stagnant afterwards. This could be the beginning of declining trend if number of wells and well density tend to increase in future
- The existing regulatory framework failed to check the indiscriminate growth of wells in the state
- Enactment of APWALTA did not help in systematic development and management of groundwater in the State after 2002.
- The free electricity policy of the existing government is in contradiction of the objectives of APWALTA and further deepened the crisis in electricity sector and groundwater situation
- Though limited hours of electricity supply, there is no restriction / regulation on pump capacity or depth of pump or number of wells per person
- It has become an “open access resource” in absence of neither effective government control nor local people’s control. The notion of groundwater management as a common property resource with concern for equity and sustainability is missing in the present regulatory framework
- Groundwater is effectively privatized in absence of state control and regulation on use and conservation of groundwater

As per APWALTA, drilling new bore wells is not allowed within a specified distance from an existing irrigation bore well. This restriction denies many farmers access to groundwater, while the existing bore well owners continue to enjoy unrestricted access to groundwater. Social regulations and mutual sharing of water is required to address this disparity created by APWALTA. It is suggested to amend APWALTA and provide measures and incentives for farmers to come together and share from existing bore wells within the stipulated distance from existing bore wells, instead of drilling new bore wells. Introduce differential and higher incentives on micro irrigation systems to groups of farmers willing to share water.

Alternative approaches such as social regulations in groundwater management and sharing mechanisms shall be scaled-up for ensuring equitable distribution of groundwater without stressing the energy and groundwater resources. Local self governments (*gram panchayats*) shall be empowered by APWALTA to manage and regulate the groundwater resources within their area of operation.

9. References

1. APTRANSCO. 2008. Performance and Statistics, Andhra Pradesh Transmission Corporation, http://aptranscorp.com/pact01.pdf
2. CPDCL, Andhra Pradesh.2008-09. ARR and Tariff Proposal for the Retail Supply Business for the year 2008-09.
3. Directorate of Economics and Statistics, GoAP.2006, AP economic survey report 2005-2006
4. Department of Disaster Management, GoAP. 2003. A Document on Management of Drought.
5. Government of Andhra Pradesh. 2002. Andhra Pradesh Water Land and Trees Act (APWALTA).

6. Government of Andhra Pradesh. 2004. Andhra Pradesh Water Land and Trees Act (Amendment).
7. Government of Andhra Pradesh. 2006. Failed Bore Well Compensation Scheme, G.O. Rt no.1099.
8. Ground Water Department, GoAP. 2006. Groundwater Resources (2004-2005), Andhra Pradesh (Volume I & II).
9. Ministry of Rural Development, GoAP. 2006. Progress Reports on Implementation of APWALTA, http://rd.ap.gov.in/WALTAReports.htm
10. Ministry of Water Resources, GoI (1993-94), 2nd Minor Irrigation Census
11. Ministry of Water Resources, GoI (2000-01), 3nd Minor Irrigation Census
12. Rama Mohan R.V.(2007), Social Regulation of Groundwater and its Relevance in Existing Regulatory Framework in Andhra Pradesh, India, Proceedings of Summary Workshop of Groundwater Governance in Asia Program, IWMI, New Delhi