37
2012

IWMI-TATA
Water Policy Program

Andhra Pradesh Farmer Managed Groundwater Systems (APFAMGS) is a celebrated project aimed at enlightened management of groundwater by farmers emanating from knowledge demystification. Based on early results, earlier studies and evaluations of AFPAMGS have pronounced it a resounding success. Consequently, the approach is being promoted for replication elsewhere in the country. Our field studies this year, however, present a contrary picture. The remnants of practices from APFAMGS and their likely impacts reflect poorly on the long term sustenance of efforts, after the project ended and the local support organizations withdrew. This offers lessons for APFAMGS and all similar efforts on whether farmers can willingly, voluntarily and sustainably manage their groundwater resources without long-term external support.

Water Policy Research

# HIGHLIGHT

## Andhra Pradesh Farmer Managed Groundwater Systems (APFAMGS)

### A Reality Check

**Shilp Verma**
**Sunderrajan Krishnan**
**Ankith Reddy V. and**
**K. Rajendra Reddy**

Download this highlight from
www.iwmi.org/iwmi-tata/apm2012

# Andhra Pradesh Farmer Managed Groundwater Systems (APFAMGS)
## A Reality Check[1]

**Research highlight based on Krishnan and Verma (2011); and Reddy and Reddy (2012)[2]**

Community management of water resources has been seen to supplement and, in some cases, act as an alternative to public and market based management designs. Experiments in irrigation systems, especially canals and tanks, are numerous and widely studied. The Participatory Irrigation Management (PIM) paradigm has evolved over the past few decades with varied degrees of success, both globally and in India (Mukherji et al. 2009). However, a lot less is available on experiments with community management of groundwater; COMMAN (2005) and Kulkarni (2011) being rare exceptions.

### Groundwater: A classic CPR

Groundwater is a classic common pool resource (CPR). Its provision is relatively inexpensive; access is near-universal and also possible indirectly (via the pump irrigation market); while exclusion is prohibitively costly, if not impossible. Groundwater extracted and consumed by one user becomes unavailable for other users, at least in the same time and space. Moreover, as an 'invisible resource', its extent and limits are difficult to perceive. Secular long term decline in groundwater table often occurs on a large scale and cannot be reversed by individual action. Moreover, by the time there is widespread realization about the decline; most users have gotten accustomed to non-sustainable levels of resource use. Any potential recovery takes a long time and requires high quality information, functional regulation and cooperation among a large number of users (Schlager 2007). Groundwater over-exploitation is therefore not only common but rampant; especially so in peninsular India where the hard-rock aquifers have limited storage capacity.

Ostrom (2001) argued that users design and adopt rules for sustainable resource management if the perceived benefits exceed the rule making, monitoring and enforcement costs; and if they perceive that they will be able to enjoy the benefits of improved management. For this to happen, Ostrom defined resource and user characteristics that would facilitate self-governance (Table 1).

### APFAMGS: A unique experiment

The Andhra Pradesh Farmer Managed Groundwater System (APFAMGS) project is an enabling intervention for managing groundwater overdraft through voluntary self-regulation. The project inverts the conventional approach to groundwater management and instead of an external entity determining and actively policing the limits to groundwater withdrawal, APFAMGS encourages farmers to collect local water data and make collective resource use decisions. The result "*may be the first example globally of large-scale success in groundwater management by communities*" (Garduño et al. 2009).

APFAMGS has been implemented in 638 habitations clustered into 63 habitations across seven drought-prone districts of Andhra Pradesh through 9 partner NGO's (FAO 2010; Figure 1).

At the heart of the APFAMGS approach is the belief that demystification of science of hydrology – through farmer training in measurement and analysis of water data - would lead them to sustainable management of the resource without unduly affecting their farming livelihoods. The project undertook extensive training of farmers (Farmer Water Schools) and established a hydrological monitoring system (Rainfall Data, Observation Wells, Groundwater Level Data) to facilitate an annual, participatory exercise of community decision making (Crop Water Budgeting). The crop water budgeting process, it was believed, would encourage appropriate demand management and result in sustainable resource management.

[1]This IWMI-Tata Highlight is based on research carried out under the IWMI-Tata Program (ITP). It is not externally peer-reviewed and the views expressed are of the author/s alone and not of ITP or its funding partners - IWMI, Colombo and Sir Ratan Tata Trust (SRTT), Mumbai.

[2]This paper is available on request from p.reghu@cgiar.org

**Table 1 Resource and user characteristics to facilitate self-governance of groundwater**

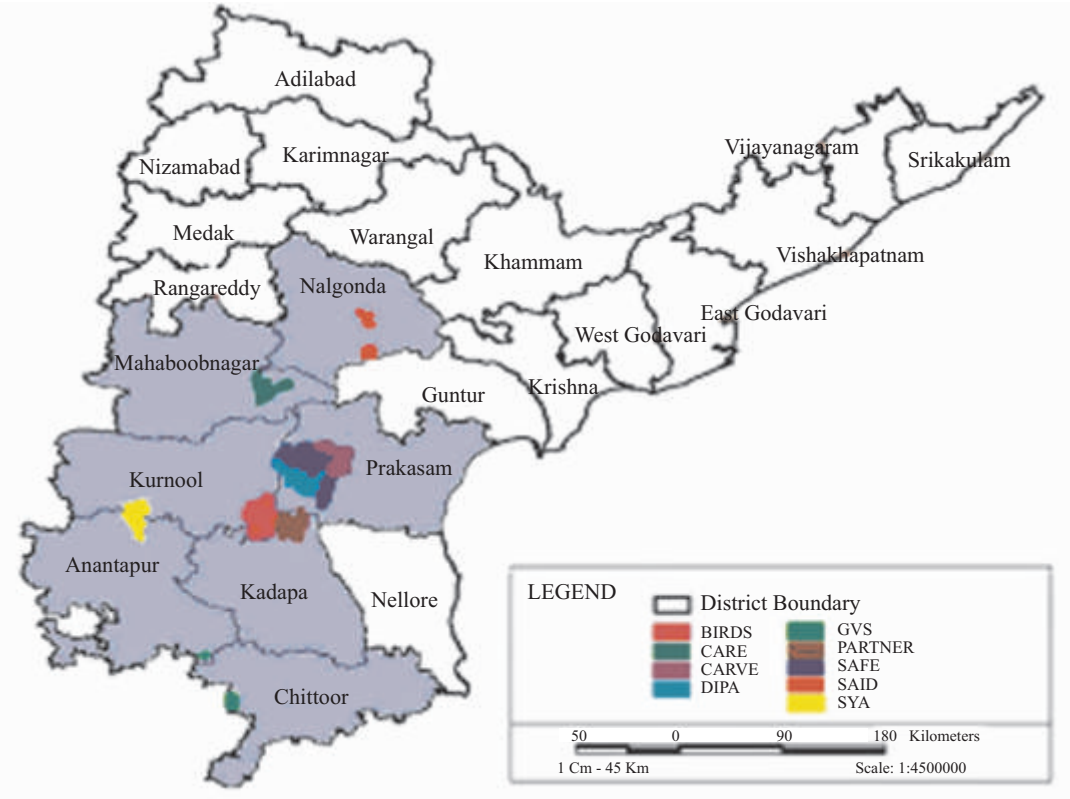
| Characteristics | Description | The Case of Groundwater |
|---|---|---|
| **Resource Characteristics** | | |
| **Feasible Improvement** | *Improvement in resource availability through user action should be feasible* | Feasible in most cases although recovery is very slow |
| **Reliable Indicators** | Reliable and valid indicators of the condition of the resource should be available at relatively low costs | These are difficult to obtain given the *invisible* nature of the resource. However, users develop practical thumb-rules and heuristics on how their wells and aquifers behave based on years of experience. |
| **Predictability** | The flow of resource units should be predictable | |
| **Spatial Extent** | The resource system should be sufficiently small such that users can develop accurate knowledge of external boundaries and internal micro-environments | |
| **User Characteristics** | | |
| **Salience** | Dependence of the user community on the resource is high | Usually true in the case of groundwater |
| **Shared Understanding** | Users have a good understanding of how the resource system operates and how their actions influence it | Users develop heuristics about the resource; but this is often done individually, not collectively |
| **Low Discount Rate** | Appropriators use a sufficiently low discount rate in relation to future benefits from the resource | Farmers are often accused to weigh short-term gains more than long-term benefits |
| **Trust and Reciprocity** | Users trust each other to follow mutually determined rules and relate to each other with reciprocity | Even when such trust exists at the village level, users are often suspicious of *unknown* users in other villages that share the same aquifer |
| **Autonomy** | Users are able to define rules autonomously without being over-ruled by external authorities | Users have little formal authority to regulate the resource |
| **Prior Experience** | The user community has prior organizational experience and local leadership | Variable |

Source: Adapted from Krishnan and Verma (2011)

Much of APFAMGS' success can be seen in the framework of Elinor Ostrom who famously laid out eight design principles to govern the Commons (Ostrom 1990). APFAMGS follows most of them: it roughly defined resource boundaries by hydrological unit networks (HUNs); rules are determined by users and can be modified to match local conditions; disputes are settled informally and easily; governance rises in nested tiers, from the farmers via the GMC (Groundwater Management Committee) to the HUN and the tiered structure of project implementing NGOs (Table 2). The one key Ostrom principle that APFAMGS doesn't deploy is that of graduated sanctions for violators. It has been argued that somehow, APFAMGS instilled among its farmers a respect for each other's needs, thus eliminating the need for sanctions. However, this makes replication of the model all the more difficult (Subramanian 2010).

In 2012, ITP supervised two IRMA student interns to carry out a quick assessment of APFAMGS (Reddy and Reddy 2012). The objective of the study was to understand the processes underlying APFAMGS and to carry out a reality check some years after the project got

**Figure 1 Project area of APFAMGS**




Source: FAO (2010)

**Table 2 Ostrom's design principles in APFAMGS**

| | Ostrom Principles | APFAMGS |
|---|---|---|
| 1. | Clearly defined user boundaries | ☑ Yes, hydrological units defined as rough approximations for aquifer boundaries |
| 2. | Match governing rules to local needs and conditions | ☑ Yes, rules set by users, not by outsiders. |
| 3. | Ensure that users can modify rules | ☑ Yes, rules flexible to temporal and geographical contexts in the annual process of Crop Water Budgeting (CWB) |
| 4. | Ensure universal legitimacy of rules | ☒ No formal recognition of the authority of GMCs and HUNs; social sanctions with informal authority suggested. |
| 5. | Develop self-monitoring systems | ☑ Yes, users extensively trained and system of hydrological monitoring put in place |
| 6. | Graduated sanctions for violators | ☒ No, not formally defined; GMC / HUNs may impose social sanctions |
| 7. | Accessible, low-cost means for dispute resolution | ☒ No, not formally defined; GMC / HUNs may take up this role |
| 8. | Nested tiers of governing institutions | → Partial, GMCs at habitation level; HUNs at aquifer level; nested project implementing NGOs. But, no direct links or defined relationship with formal water authorities |

over. The study involved interviews with farmers in more than 60 APFAMGS habitations besides discussions with officials and experts in and around the project area.

**Impressions from the field**

During their 8-week internship with IWMI, Reddy and Reddy (2012) did field surveys in 5 districts of Andhra Pradesh. The first leg of the fieldwork was exploratory and covered 18 habitations in Nalgonda and Mahbubnagar districts. The second phase of fieldwork was more structured and covered 49 habitations in Ananthapur, Chittoor, Kadapa, Kurnool and Prakasham districts. In every location, the students contacted the implementing NGO and selected HUNs and habitations in consultation with them, making sure that the most responsive/ best performing habitations and HUNs were included in the sample. Our sample 49 habitations were therefore purposively selected and if anything, the sample was biased positively to include the best habitations.

The students observed, *"...what we had read in the FAO reports was very much different when we look at the ground reality in terms of attitude of the community and outcomes of the project..."*. Their overall impression was that most of the APFAGMS initiated practices and activities have been abandoned by the farmers. This was so in almost every habitation they visited except the two HUNs in Chittoor district and one habitation (R Krishnapuram) in Kurnool.

Reddy and Reddy (2012) collected data on farmer field schools (FFS), rainfall data collection (RF), observation/discharge wells (OB), groundwater level data (GW), public displays of farmer-gathered data (PD), the annual crop water budgeting (CWB) process as well as innovative farming practices (SRI and NPM) introduced by the implementing NGOs during the project period. For each of these activities, the students asked a group of farmers (well owners and GMC committee members) in each habitation if the activity was undertaken during the project period (reference year: 2008) and whether the activity continued to date (reference year: 2012).

**Hydrological Data Collection and Public Display**

As Table 3 and Figure 2 show, the practice of farmers collecting rainfall, discharge and groundwater level data has been all but abandoned in most of the APFAMGS habitations and HUNs. In fact, our survey found that in some of the habitations, the practices were discontinued even during the project period. The findings can be briefly summarized as follows:

- Out of the 49 habitations visited, 43 reported that farmers from the habitation attended Farmer Field Schools / Farmer Water Schools during the project.
- 20 rainfall data stations were established and 34 farmers were provided training in the surveyed habitations. Of the 20 stations, 18 were reported to be functional for the entire duration of the project while only 5 were found to be functional at the time of the survey.
- More than 150 observation / discharge wells were designated in the surveyed habitations; of these less than 30 were reported to be functional at the time of the survey.
- Groundwater level data was collected in 43 out of 49 habitations during the project period. However, at the time of the survey, only 15 habitations were found to be continuing with this data collection.
- Out of the 49 habitations, only 32 reported that data collected by farmers was displayed prominently in public places. At the time of the survey, public display of data was restricted to only 4 habitations.

Reddy and Reddy (2012) observed that in some habitations, data monitoring was discontinued either because the equipment was rendered useless or needed repair/replacement. They also argued that while the expectation was that farmers would find this data collection and public display useful in making farming decisions, farmers prefer to rely on traditional heuristics that they have developed over the years about the nature of their aquifers and behavior of their wells. They also reported that during the project period, farmers felt obligated to undertake data collection due to repeated visits and encouragement by the implementing NGOs. After the project, these visits stopped and farmers neither felt obligated nor interested in continuing the practice. This gloomy picture was not true everywhere and there were some notable exceptions.

Farmers in R Krishnapuram (Kurnool district) had been encouraged to organize themselves into cooperative credit societies after the conclusion of the APWELL project. This society was already functional when the APFAMGS activities started and the office bearers of the credit cooperative also became committee members in the GMC. The credit cooperative society benefitted from selling data collected under APFAMGS during the project period. It therefore appointed a salaried employee and made him responsible for data collection and public display.

In both the HUNs surveyed in Chittoor, the status of data collection and other APFAMGS-initiated practices stood out. Three out of the four rainfall stations and 21 of the 28 observation/discharge wells were found to be functional. All the 12 habitations surveyed were regularly collecting groundwater level data while only 3 habitations were prominently displaying the data in public places (as opposed to 7 during the project period). Reddy and Reddy (2012) attribute this to superior institutional leadership; continued commitment from the implementing NGO even after the project period; high reliance on groundwater for irrigation; and alarmingly low groundwater levels (500 – 800 feet). The last two factors made farmers more open to measures for checking groundwater depletion such as adoption of drip irrigation, which also suited the prominent tomato crop.

It is also noteworthy that the president of one of the HUNs was also closely associated with the local dairy and had helped around 450 farmers to get loans from the dairy. Reddy and Reddy (2012) suggest that such association was critical to the continuation of data collection as the habitations were required to regularly submit data to the HUN office. They also suggested some other possible reasons for success: committee members in both the Chittoor HUNs were comparatively younger and better educated; school children were trained and encouraged to collect rainfall data; demand measurement measures were complemented by supply side interventions such as the construction of injection wells.

**Crop Water Budgeting and Improved Farming Practices**

While data collection and public display may be termed as the *rituals* of APFAMGS, the tangible impact of APFAMGS was to come from the annual practice of well owners coming together, taking stock of the shared groundwater resource (using the data collected by them) and taking collective decisions on cropping and irrigation intensity. Of the 49 habitations surveyed, 45 engaged in CWB during the project period. However, at the time of the survey, only 16 habitations reported continuing the practice (Table 4).

> "*CWB is a good concept, if followed by every bore well user. But without regulation on electricity and water, this concept will not work*" (former APFAMGS field officer)

> "*CWB is a useful concept, but the problem is we do not have any regulation to take a collective decision and ensure that every bore well user follows it. We can just request fellow farmers to opt for water saving techniques and it's up to him to follow it or not*" (GMC committee members)

> – *c.f.* Reddy and Reddy (2012)

The above quotations nicely sum up the reasons for discontinuation of CWB. Two key Ostrom principles that APFAMGS left out were 'universal legitimacy of rules' and 'graduated sanctions for violators'. During the project period, regular visits and support from implementing NGOs gave legitimacy to the project activities and farmers felt obliged to continue the prescribed activities. In several habitations, farmers reported an inability to undertake CWB independently as it was mainly done by NGO staff and GMC committee members. Moreover, the project also funded the conduct of CWB workshops financially (to cover food and travel expenses) but few were willing to meet these expenses on their own. Once the NGOs withdrew, farmers lost faith and in several habitations, farmers doubted that everyone would follow community decisions with the NGO out of the picture.

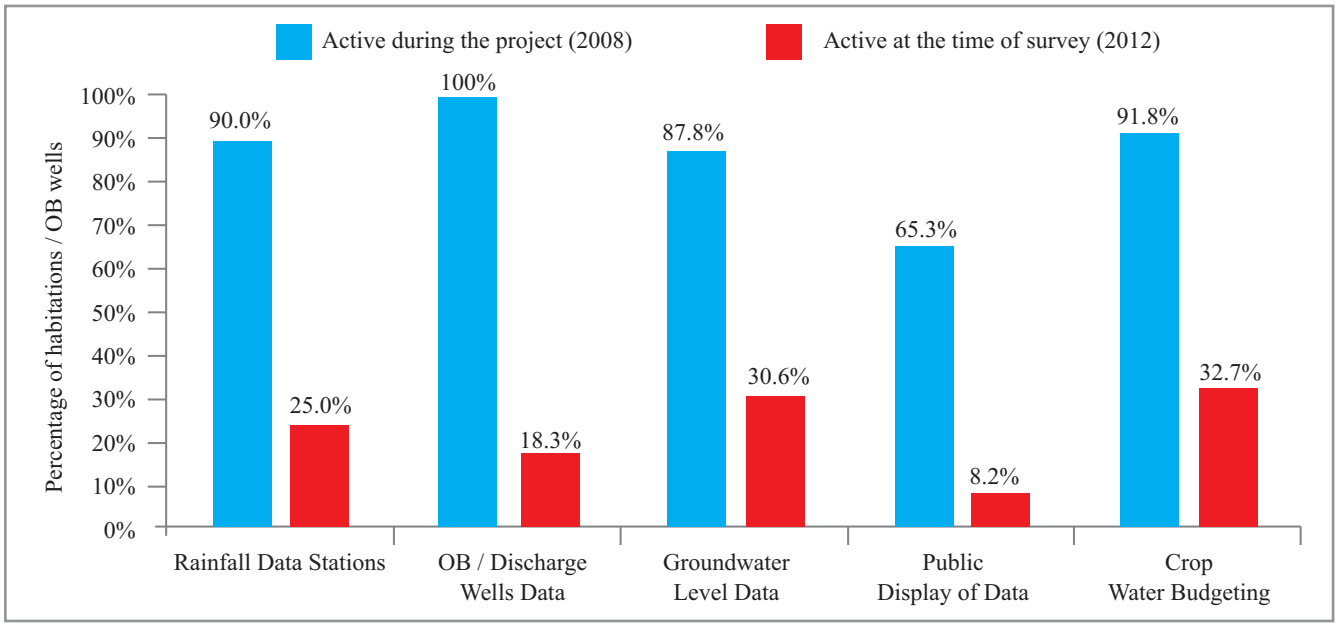
Once again, and perhaps for the same reasons, all the 12 habitations surveyed in Chittoor and 4 in the Pedavagu HUN in Kurnool were exceptions and were found to be continuing with CWB (Table 4).

APFAMGS also encouraged farmers, via the Farmer Field Schools, to adopt improved farming practices such as system of rice intensification (SRI) and integrated nutrient and pest management (NPM). These were also piloted in some of our sample habitations. Nine habitations reported positive experience and results out of 24 SRI pilots; while 12 habitations reported positive results out of 19 NPM pilots. At the time of the survey, only one habitation in Chittoor reported continuing with SRI. Interestingly, 16 habitations reported practicing NPM even though only 12 reported positive experience during the APFAMGS pilot. Reddy and Reddy (2012) attribute this to rising prices of chemical fertilizers rather than encouragement from APFAMGS.

**Institutions: GMCs and HUNs**

Without any formal recognition or authority and in the absence of implementing NGOs nudging them to continue APFAMGS activities, GMCs and HUNs in most places were found to be withering. An indication of this can be had from the changes in the frequency of meetings over time in the surveyed habitations. During the project period, 42 of the 49 habitations used to conduct monthly meetings, 3 had quarterly meetings, and one habitation conducted only one annual meeting. At the time of the

**Figure 2 Status of APFAMGS-initiated practices during and after the project**




Data Source: Reddy and Reddy (2012)

survey, 31 habitations reported not having any meetings at all, and 16 reported quarterly meetings (Error! Reference source not found.). Most GMC committee members cited the absence of implementing NGO as the reason why the meetings have stopped. They did not believe that farmers would come to attend meetings called by them; or would listen to them unless the NGO staff was there to conduct the meeting. On the contrary, farmers in Chittoor and R Krishnapuram found the meetings useful to learn about new and improved farming practices and to monitor the water data collection process.

**Table 3 Status of APFAMGS-initiated data activities in surveyed habitations**

| District | Name of the HUN (number of habitations surveyed) | | Rainfall Data Stations | | | Observation Wells | | Well Level Data | | Public Display of Data | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Established | 2008 | 2012 | 2008 | 2012 | 2008 | 2012 | 2008 | 2012 |
| Ananthapur | Bellamvanka | (05) | 2 | 2 | 0 | 22 | 0 | 5 | 0 | 5 | 0 |
| | Peddavanka | (10) | 5 | 4 | 1 | 23 | 0 | 9 | 0 | 6 | 0 |
| Chittoor | Diguvetigadda | (07) | 2 | 2 | 1 | 18 | 14 | 7 | 7 | 4 | 3 |
| | Nakkillavagu | (05) | 2 | 2 | 2 | 10 | 7 | 5 | 5 | 3 | 0 |
| Kadapa | Erravagu | (03) | 1 | 1 | 0 | 10 | 0 | 1 | 0 | 1 | 0 |
| | Erravanka | (03) | 1 | 1 | 0 | 5 | 0 | 3 | 0 | 2 | 0 |
| Kurnool | Peddavagu | (04) | 3 | 3 | 1 | 23 | 7 | 3 | 2 | 3 | 1 |
| | Thundlavagu | (06) | 2 | 2 | 0 | 27 | 0 | 4 | 0 | 2 | 0 |
| Prakasham | N R Palli vagu | (06) | 2 | 1 | 0 | 15 | 0 | 6 | 1 | 6 | 0 |
| **Total** | | **(49)** | **20** | **18** | **5** | **153** | **28** | **43** | **15** | **32** | **4** |

[3]In one of the habitations in Chittoor district, discharge data collection had to be discontinued. The equipment provided to the farmers could measure discharge provided the depth to water table was less than 450 ft. However, owing to poor rainfall in the last 2-3 years, water level in wells had fallen below 450 ft.

**Table 4 Status of APFAMGS-initiated improved farming practices in surveyed habitations**

| District | Name of the HUN (number of habitations surveyed) | | Crop Water Budgeting | | System of Rice Intensification (SRI) | | | Nutrient & Pest Management (NPM) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | During APFAMGS | After APFAMGS | Piloted in APFAMGS | Positive results obtained | Practice continued by farmers | Piloted in APFAMGS | Positive results obtained | Practice continued by farmers |
| Ananthapur | Bellamvanka | (05) | 5 | 0 | 2 | 2 | 0 | 4 | 3 | 3 |
| | Peddavanka | (10) | 10 | 0 | 0 | 0 | 0 | 4 | 1 | 1 |
| Chittoor | Diguvetigadda | (07) | 7 | 7 | 5 | 3 | 1 | 2 | 2 | 1 |
| | Nakkillavagu | (05) | 5 | 5 | 4 | 0 | 0 | 0 | 0 | 0 |
| Kadapa | Erravagu | (03) | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 2 |
| | Erravanka | (03) | 3 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| Kurnool | Peddavagu | (04) | 4 | 4 | 4 | 0 | 0 | 4 | 2 | 3 |
| | Thundlavagu | (06) | 4 | 0 | 3 | 3 | 0 | 3 | 3 | 4 |
| Prakasham | N R Palli vagu | (06) | 4 | 0 | 1 | 1 | 0 | 2 | 1 | 0 |
| Total | | **(49)** | **45** | **16** | **24** | **9** | **1** | **19** | **12** | **16** |

**Table 5 Frequency of GMC and HUN meetings**

| Frequency of Meetings | During APFAMGS | After APFAMGS |
|---|---|---|
| Monthly | 42 | 0 |
| Quarterly | 3 | 16 |
| Annual | 1 | 0 |
| No Meetings | 0 | 31 |
| Not Sure | 3 | 2 |
| | **49** | **49** |

## Conclusions

The APFAMGS project received much deserved policy attention and appreciation. It has been a unique experiment that offers valuable lessons for participatory resource management. While some studies have drawn more cautious and pragmatic lessons from the APFAMGS experience (Pahuja et al. 2010[4]), others have gone over-board in declaring the APFAMGS experiment an indubitable and unreserved success and a model 'ready for replication' throughout the country (FAO 2010). Some of this is already happening and several state governments are now contemplating / initiating APFAMGS-like projects. Perhaps in anticipation, the implementing NGOs of APFAMGS have also re-organized themselves into *Association Promoting Farmer Managed Groundwater Systems*[5]. This study serves a cautionary note to 'copy-paste' style up-scaling and hasty replication.

The APFAMGS Project Terminal Report (FAO 2010) noted that, "*Making visible the otherwise invisible source of groundwater is a prerequisite for building up collective action*". That might well be true but is it sufficient? The idealism of people's participation in governance of natural resources has absorbed many a minds – of research scientists, policy makers and development workers. Indeed, it is hard to deny people's participation in the

[4]This World Bank report interestingly notes that, "*The reductions in groundwater draft in APFAMGS are not coming from altruistic collective action, but from the individual risk management and profit-seeking decisions of thousands of farmers.*" However, it bases these conclusions on early evidence available while the project was still on, comparing data from 2005-06, 2006-07 and 2007-08.

[5]The old APFAMGS website (www.apfamgs.org) appears to have been closed down and the new website (www.apfamgs.net) presents APFAMGS as "A network of NGOs for demystifying science and technology for sustainable development" with a prominent 'Coming Soon' sign.

management of any resource that connects with people as intimately as water. However, the difficult-to-obtain enabling conditions and policy environment required for participatory approaches to succeed must not be ignored. These difficult requirements restrict the replication potential of programs that rely heavily on voluntary participation from people based on enlightened understanding of their resource. As the terminal report cautioned, "*Farmer's interests in groundwater management are linked to managing the production and livelihood risk. Farmers may have little interest in water conservation for its own sake*". Reddy and Reddy (2012) confirmed this by their observations in the field.

We sum up our conclusions as follows:

1. Success of APFAMGS Model: With the benefit of hindsight, some of the conclusions of the APFAMGS evaluation (FAO 2008) and terminal (FAO 2010) reports seem to be premature and overly optimistic. The same can be said about Garduño et al. (2009). Just a few years after the project concluded, APFAMGS-initiated activities seem to be in disarray. Exceptions to this general trend can be found in habitations where NGO-support has continued despite closure of the project and where the APFAMGS-initiated institutions have managed to find strong association with other important local economic institutions such as credit cooperative or dairy.

2. Participatory Hydrological Knowledge Network: The APFAMGS experiment has demonstrated a useful model for demystification of hydrology and community participation in hydrological knowledge generation. However, as the results of this study show, sustaining such a network is not going to be easy. Farmers are likely to respond better in areas where groundwater dependence and scarcity is higher; and if traditional heuristics developed over years of farming experience are integrated into the knowledge framework. Ongoing external (NGO/donor) support will be required for a much longer time and it is unlikely that communities would be willing and able to assume complete ownership of the idea in a small time frame.

3. Business Model: Some of the early successes in APFAMGS not only managed to collect hydrological data but also managed to generate some revenue from data sales and from visitors. FAO (2010) lists 22 HUNs that together generated revenue of Rs. 137845 (ranging from Rs. 500 to Rs. 10560). It is not clear how this money was utilized or whether such revenue generation continued. However, as the case of R Krishnapuram shows, even small amounts can be leveraged to boost community interest. It is unlikely that in any habitation, farmers will voluntarily continue to spend time and resources on participatory hydrological monitoring unless the data itself can generate some tangible returns. Several habitations reported that their data monitoring equipment needed repair/replacement; it is only fair that people engaged in data collection be paid for their service to the community. Such a mechanism would require a sound business model with a reliable and recurring revenue stream.

4. Sanctions and Legitimacy: Discontinuation of monitoring mechanisms and the absence of sanctions for defaulters are likely to further erode the sustainability of the APFAMGS model. In the absence of an external authority, GMCs and HUNs lose their legitimacy, leading to a breakdown of trust and reciprocity. Critical to the success of any community action on restricting groundwater pumping is the belief / assurance that all well owners will abide by group decisions. The fact that this belief does not come naturally and easily is not a sign of lack of mutual respect among farmers. It is merely an acknowledgement of the fact that in times of distress, every farmer is susceptible to breaking all rules to protect his crop and livelihood.

5. Indirect Approaches: Electricity supply is a powerful indirect tool for groundwater management. As the experience in Gujarat shows, the groundwater economy can be closely regulated through electricity by redefining the boundary conditions of individual action (Shah and Verma 2008). One of the reasons why groundwater over-exploitation is rampant in western and peninsular India is the provision of free or highly subsidized electricity supply, although unreliable and of variable quality. The APFAMGS model of groundwater management attempts to alter individual behavior but largely ignores the impact of such critical policy variables. If the GMC and HUN can organize themselves around electricity feeders and work in partnership with the electricity utility, they might be able to deliver improved power quality to farmers and gain a powerful monitoring mechanism in the process.

**References**

COMMAN. 2005. Community management of groundwater resources in rural India. Calow, R. and Macdonald, D. (eds.), unpublished research report, 95p. Background papers on the causes, symptoms and mitigation of groundwater overdraft in India, British Geological Survey.

FAO. 2008. Andhra Pradesh Farmer Managed Groundwater Systems: Evaluation Report (APFAMGS - GCP/IND/175/NET). Rome: Food and Agriculture Organization of the United Nations (FAO). Available online (last accessed: 12th November 2012): http://www.fao.org/nr/water/apfarms/reports/GCPIND175NET-APFAMGS_eval_final.pdf

FAO. 2010. Andhra Pradesh Farmer Managed Groundwater Systems Project: Terminal Report (GCP/IND/175/NET). Rome: Food and Agriculture Organization of the United Nations (FAO). Available online (last accessed: 12th November 2012): http://www.solutionsforwater.org/wp-content/uploads/2011/12/APFAMGS-Terminal-Report.pdf

Garduño, H., Foster, S., Raj, P. and van Steenbergen, F. 2009. Addressing groundwater depletion through community-based management actions in the weathered granitic basement aquifer of drought-prone Andhra Pradesh – India. Case Profile Collection Number 19, GWMATE Briefing Notes Series. Washington: The World Bank.

Krishnan, S. and Verma, S. 2011. Towards a participatory approach for groundwater management. Anand: Foundation for Ecological Security (FES).

Kulkarni, H. 2011. Groundwater management through the 'commons' lens: Recognizing complexity. Conference paper, *Sustaining Commons: Sustaining Our Future*, Hyderabad: 13th Biennial Conference of the International Association for the Study of the Commons (IASC).

Mukherji, A., Fuleki, B., Shah, T., Suhardiman, D., Giordano, M., and Weligamage, P. 2009. Irrigation Reform in Asia: A review of 108 cases of irrigation management transfer. Final report to the Asian Development Bank, October. Colombo: International Water Management Institute.

Ostrom, E. 1990. *Governing the Commons: The evolution of institutions for collective action*. Cambridge: Cambridge University Press.

Ostrom, E. 2001. Reformulating the Commons. In: Burger, J., Ostrom, E., Norgaard, R.B., Policansky, D. and Goldstein, B.D. (eds.) "*Protecting the Commons: A framework for resource management in the Americas".* Washington DC: Island Press, pp. 17-41.

Pahuja, S., Tovey, C., Foster, S. and Garduño, H. 2010. Deep wells and prudence: Towards pragmatic action for addressing groundwater overexploitation in India. Washington: The World Bank.

Reddy, A.V. and Reddy, K.R. 2012. Study of Andhra Pradesh Farmer Managed Groundwater System (APFAMGS). Unpublished OTS report, Anand: IWMI-Tata Water Policy Program.

Schlager, E. 2007. Community Management of Groundwater, In Agricultural Groundwater Revolution: Opportunities and Threats to Development, CAB Series.

Shah, T. and Verma, S. 2008. Co-management of electricity and groundwater: An assessment of Gujarat's Jyotirgram Scheme. *Economic and Political Weekly,* 43 (7): *59-66*.

Subramanian, S. 2010. Charting a conservation path. LiveMint, May 26. (Last accessed: Aug 11, 2012; http://www.livemint.com/2010/05/26204739/Charting-a-conservation-path.html

## About the IWMI-Tata Program and Water Policy Highlights

The IWMI-Tata Water Policy Program (ITP) was launched in 2000 as a co-equal partnership between the International Water Management Institute (IWMI), Colombo and Sir Ratan Tata Trust (SRTT), Mumbai. The program presents new perspectives and practical solutions derived from the wealth of research done in India on water resource management. Its objective is to help policy makers at the central, state and local levels address their water challenges – in areas such as sustainable groundwater management, water scarcity, and rural poverty – by translating research findings into practical policy recommendations. Through this program, IWMI collaborates with a range of partners across India to identify, analyze and document relevant water-management approaches and current practices. These practices are assessed and synthesized for maximum policy impact in the series on Water Policy Highlights and IWMI-Tata Comments.

Water Policy Highlights are pre-publication discussion papers developed primarily as the basis for discussion during ITP's Annual Partners' Meet. The research underlying these Highlights was funded with support from IWMI, Colombo and SRTT, Mumbai. However, the Highlights are not externally peer-reviewed and the views expressed are of the author/s alone and not of ITP or either of its funding partners.

## IWMI OFFICES


**IWMI Headquarters and Regional Office for Asia**
127 Sunil Mawatha, Pelawatte
Battaramulla, Sri Lanka
Tel: +94 11 2880000, 2784080
Fax: +94 11 2786854
Email: iwmi@cgiar.org
Website: www.iwmi.org

**IWMI Offices**

**SOUTH ASIA**
Hyderabad Office, India
C/o International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
401/5, Patancheru 502324, Andhra Pradesh, India
Tel: +91 40 30713735/36/39
Fax: +91 40 30713074/30713075
Email: p.amerasinghe@cgiar.org

New Delhi Office, India
2nd Floor, CG Block C, NASC Complex
DPS Marg, Pusa, New Delhi 110 012, India
Tel: +91 11 25840811/2, 65976151
Fax: +91 11 25842075
Email: iwmi-delhi@cgiar.org

Lahore Office, Pakistan
12KM Multan Road, Chowk Thokar Niaz Baig
Lahore 53700, Pakistan
Tel: +92 42 35299504-6
Fax: +92 42 35299508
Email: iwmi-pak@cgiar.org

**SOUTHEAST ASIA**
Southeast Asia Office
C/o National Agriculture and Forestry Research Institute (NAFRI)
Ban Nongviengkham,
Xaythany District,
Vientiane, Lao PDR
Tel: + 856 21 740928/771520/771438/740632-33
Fax: + 856 21 770076
Email: m.mccartney@cgiar.org

**CENTRAL ASIA**
Central Asia Office
C/o PFU CGIAR/ICARDA-CAC
Apartment No. 123, Building No. 6, Osiyo Street
Tashkent 100000, Uzbekistan
Tel: +998 71 237 04 45
Fax: +998 71 237 03 17
Email: m.junna@cgiar.org

**AFRICA**
Regional Office for Africa and West Africa Office
C/o CSIR Campus, Martin Odei Block,
Airport Residential Area
(Opposite Chinese Embassy), Accra, Ghana
Tel: +233 302 784753/4
Fax: +233 302 784752
Email: iwmi-ghana@cgiar.org

East Africa & Nile Basin Office
C/o ILRI-Ethiopia Campus
Bole Sub City, Kebele 12/13
Addis Ababa, Ethiopia
Tel: +251 11 6457222/3 or 6172000
Fax: +251 11 6464645
Email: iwmi-ethiopia@cgiar.org

Southern Africa Office
141 Cresswell Street, Weavind Park
Pretoria, South Africa
Tel: +27 12 845 9100
Fax: +27 86 512 4563
Email: iwmi-southern_africa@cgiar.org

**IWMI SATELLITE OFFICES**
Kathmandu Office, Nepal
Jhamsikhel 3, Lalitpur, Nepal
Tel: +977-1-5542306/5535252
Fax: +977 1 5535743
Email: l.bharati@cgiar.org

Ouagadougou Office, Burkina Faso
S/c Université de Ouagadougou Foundation
2iE 01 BP 594 Ouagadougou, Burkina Faso
Tel: +226 50 492 800
Email: b.barry@cgiar.org



**IWMI-Tata Water Policy Program**
c/o INREM Foundation
Near Smruti Apartment, Behind IRMA
Mangalpura, Anand 388001, Gujarat, India
Tel/Fax: +91 2692 263816/817
Email: iwmi-tata@cgiar.org


IWMI International Water Management Institute

2012 STOCKHOLM WATER PRIZE LAUREATE

IWMI is a member of the CGIAR Consortium and leads the:

CGIAR Research Program on Water, Land and Ecosystems