International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(6): 2283-2287

Received: 17-09-2018
Accepted: 19-10-2018

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A case study on contemporary water management innovation (CWMI) in sustainable agriculture: Farmers joined hands for mutual survival and prosperity: The case of Kummarvandlapalli

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Abstract
Water management was virtually unknown to farmers. Farmers had been using scarce water resources injudiciously, which had resulted in undue wastage of water. Defunct water harvesting structures were not being repaired in time. The farmers also never saw 'water sharing' and 'water economy' as a priority issue. Social exclusion was at a high and the Dalit community had no access to major sources of irrigation water but it become possible through contemporary water management innovations sharing of water to dalit community as well through water sharing practices. Dryland farmers faced with an uncertainty of declining water table, drying up of the aquifer in times of a drought year when rains fail to recharge the water aquifer and raise water table. Yet they were not worried, because under the social regulation programme, water sharing is now made possible. The striking characteristics of this contemporary innovations are that they address the community mobilization and elicit farmers' participation for concerted group actions for solving all inter-related problems through farming systems approach in the whole agro-ecosystem. A case study analysis revealed the way the water sharing group of farmers were able to grow crops through the use of social regulatory measures in water sharing groups, micro-irrigation and conservation agronomic practices and were able to enhance their incomes.

Keywords: Contemporary water management innovations (CWMI)

Introduction
Sustainable use of ground water for agriculture needs no overemphasis, as there is overexploitation of ground water resources in India. There is also heavy dependence of irrigated agriculture on ground water resources. It is estimated that 84% of the addition to net irrigated area over the last four decades has come from ground water (GOI, 2011). Besides, ground water is the main source of drinking water, especially in arid and semi-arid regions of the country. Over 80% of India's drinking water needs are met from ground water resources (Ibid). The mid-term appraisal of the 11th Plan reports that 60% of the districts in the country have problems pertaining to quantitative and qualitative aspects of ground water (GOI, 2011a). The competitive digging of bore wells led to faster depletion of ground water levels. Failure of bore wells is one of the main reasons for the farmer suicides in several states of the country, especially in drought prone areas (Reddy and Galab, 2005; Sreedhar and Dasaratharamaiah, 2006) [10, 13]. Andhra Pradesh is one of the 7 states in the country with a considerable number of overexploited units of ground water (Rana Chatterjee and Purohit, 2009) [9]. The competitive digging of bore wells is intensified due to policies such as free power supply and subsidisation of micro irrigation systems. There is also no effective legislation to control the competitive digging of bore wells; the Andhra Pradesh Water, Land and Trees Act (APWALTA), 2002 [2] proved ineffective in this regard. Besides, there is no social regulation mechanism to control the competitive digging of bore wells. There is also no proportionate increase in the agricultural productivity in drought prone areas with the increase in the number of bore wells. This study promoted a new approach to protect rainfed agriculture through pooling and sharing of ground water for providing critical irrigation to rainfed crops with the active involvement of local communities. The approach involved a shift from individual farmer approach to area based approach for irrigation and from treating ground water as a private property to ground water as a common property.
The study aimed to capture the competitive digging of bore wells and provide access to ground

water for rainfed crops for critical irrigation, thereby increasing the productivity of rainfed lands and ensuring food and fodder security at the household level.

An old saying can be quoted here: *'Necessity is the Mother of Invention!'* This is the starting point of innovation development. As all the farmers have had faced severe cases of water crisis, crop losses and were victims of psychological distress, they began to understand their plight and the actively participated in the discussions held by NGO activists in the group meetings in the villages. They could gather all the lost wisdom of farming with open wells and farm ponds, and the way they took care of check dams and other water conservation structures. The solutions started emerging and getting refined (Rogers, E. M. 2003) [12]. The concept of social institutions through Water sharing Groups was promoted in all villages of the Panchayat in the Ananthapur district of Andhra Pradesh with the objectives of educating community on the need to conserve water and to promote the concept of water sharing (Malgatti, M. 2008) [8]. These groups consisted of bore well owners and owners of farms receiving water from the bore well. The emphasis in this study is on the conditions of management and organization under which "farmers' participation" will succeed. The major themes are organizational size, social and economic homogeneity of members, legal status of water sharing groups, and conferment of secure property rights and the creation of a favorable bureaucratic and policy environment. Discussions in this study focus on how each of these factors influence the likelihood of success of water sharing groups. This view is inspired by the socio-economic nature of irrigation systems. The *'software'* of irrigation needs much the same emphasis as the *'hardware'* because of the importance of water economy and water sharing (Cernea and Meinzen-Dick.1994) [4]. The farmers were oriented on the need to share water with other farmers. They were reminded that water scarcity was already an issue of concern in the district and were further informed that water levels in their bore wells would go down if newer bore wells were dug in their neighbouring farms. The better option would be to part with some of their water sharing groups so that more farmers could be benefited (WASSON, 2018) [14].

The present paper seeks to present the innovation development process of Contemporary Water Management Innovation in Kummarvandlapalli village in Gadlapenta mandal of Anantapur district. An attempt is made to study the effectiveness of community level mechanism for social regulation of ground water, changes brought about in crop and water management methods due to activities taken farmers institutions (CSA, 2018) [5] under the pilot including convergence with other programmes, and assess their impact on cropping pattern and productivity of rainfed crops.

Materials and Methods

The study was conducted in dryland agro-ecosystem of Andhra Pradesh. District Ananthapur (Rayalaseema region) is purposively selected as large number of farmers are facing very grave situation in Ananthapur due to agro-ecological crises (The Hindu, 2017). A pilot study was conducted before the actual start of research work to check the availability and time taken by the farmers in this areas (Billé, R, 2010) [3]. The case study approach was specially used in the study as this method allows to record qualitative data (Yin, Robert K, 2013) [15]. The Qualitative data collected from farmers was verified used and triangulated through secondary data sources of NGO's office records. Processes involved in evolving innovations for dryland farmers that have transformed their ways of farming, their lives and living standards (Rothbauer, Paulette, 2008) [11]. Case study involved in-depth interviews of the key informants of water user groups.

Result and Discussion

Table 1: Distribution of respondents from Gandlapenta Mandals, villages and their water sharing groups in Ananthapur district

Villages in Three Mandals of Ananthapur	Name of Water Sharing Group	Bore well Owners	Non-Owners of Bore well	Total
Gandlapenta Mandal				
Karnamwaripalli	Srinivasa Ummadi Neeti Yajamanya Sangham	4	12	16
Kumarwandlapalli	Kolugunti Ummadi Neeti Yajamanya Sangham	2	10	12
Narasappagaripalli	Mallikaada Ummadi Neeti Yajamanya Sangham	2	9	11
Kamathampalli	Khadri Susthira Bhugarbha jala Yaajamaanya Sangham	4	19	23
Total	Four Societies	12	50	62

As can be seen from the results, in Gandlapenta Mandals, four water sharing societies were found, one in each village. Interesting fact was that from among the 62 farmers, only 12 farmers owned bore well and 50 farmer respondents were not owning any bore wells. This shows that the all the farmers came together to form water sharing groups and thereby get mutual benefits. 12 bore well owning farmers have vowed to provide protective irrigation to all 50 farmers when rains may fail and crops are in dire need of a live saving irrigation. Among four water sharing group due to the time limitation of the study one water sharing group i.e. Kolugunti Ummadi Neeti Yajamanya Sangham is presented here.

Changes in the Cropping Pattern

Table 2: Cropping Pattern of the Sample Farmers: 2016-17

Sl. No.	Name of the Crop	Kharif (incl. Annual)			Rabi
		Extent (acres)	Percentage to total	Extent (acres)	Percentage to total
1	Groundnut	21.85	47.0	16.5	86.8
2	Paddy	3.75	8.0		
3	Flowers	0.40	0.9		
4	Mango	7.00	15.1		
5	Tomato	6.00	12.9	2.5	13.2
6	Mulberry	2.00	4.3		
7	Redgram + Castor/ Korra	5.50	11.8		
	Total	46.5	100.0	19.0	100.0

From the above table the cropping pattern of the sample farmers in the land covered under water sharing group during 2016-17 is presented in table-1. It could be seen that groundnut accounted for only 47% of the net cultivated area during Kharif season, as against about 75% in the entire district. The rainfed crops also included Redgram, castor and korra (a coarse cereal) to the tune of about 12% of the net cultivated area. The area under paddy stood at 3.75 acres (8% of the net cultivated area), indicating a significant decline of over 100%. Further, the farmers did not cultivate paddy during the Rabi season, but grew only irrigable dry crops such as groundnut and tomato, in contrast to the situation that prevailed before the Initiative. Another important point to be noted is the nature and extent of crop diversification in respect of the sample farmers. The sample farmers revealed that they shifted towards less water intensive yet more profitable crops such as vegetables, floriculture and horticulture. The cropping pattern during 2016-17 remained the same as in 2017-18.

General scenario of Kummarvandlapalli

Table 3: Details of assets of farmers at Kummaravandla Pally

S.no	Asset	Average Worth (in Rupees)
1	House	51,000
2	Land	1,27,000
3	Education	40,000
4	Health	53,000
5	Agricultural Equipment	31,000
6	Cattle	65,000
7	Cash Deposit	28,300
8	Television	15,000
9	Vehicle	25,000

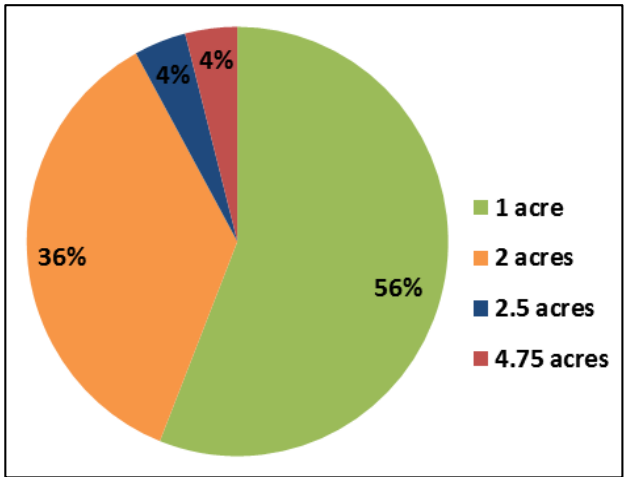

Fig 1: Land details of farmers

Kummarvandlapalli is a small village of about 55 households cultivating groundnut, red gram (pigeon pea) and Jowar (sorghum). Being a dryland area, farmers rely heavily on the rains for their livelihoods. If the rains, are good, all farmers reap bumper harvest and lead a prosperous life. If rains fall, some farmers usually provide one or two life-saving irrigations from their bore well to grow enough food for their families. If farmers did not own any bore-well they will end up with dried crops and face starvation. About 40-50 years ago, farmers used to get adequate rainfall as the forest cover, and the climate condition were normal and agro-ecosystem were healthy and doing well in ecological terms. But due to severe climate change happening around the world, the climatic condition of dryland region has become quite erratic and adverse causing stress and misery to the villagers.

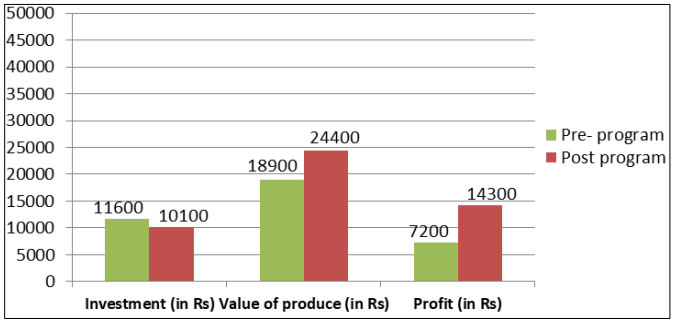

Fig 2: Scenario pre and post ground water sharing

In the last 15-20 years digging bore wells and extracting ground water over the years has depleted ground water resources and the water table has gone down year by year and farmers went for deeper boring increasing investment. Farmers who owned bore wells have started growing paddy and sugarcane, which are water gurgling crops. On seeing the success of bore wells owned farmers, other resourceful farmers too have dug up more tube wells. With this competitive digging, the aquifer, started drying up ignorant farmers too have wasted lot of water. one side, the tube wells were getting dried up and were left abandoned. Those farmers who owned tube wells had other problems like wastage of water through flood irrigation, lack of pipelines for distribution no water to crop fields. Leakage and seepage losses have forced farmers to irrigate lesser area of crop fields. The farmers who did not own bore wells were forced depend only on rains. During the seasons, when rains failed, the crop produce was less leading to shortage of food for the family. Income were quite fluctuating at the mercy of rainfall. Thus the problems of dryland regions have got aggregated and led to an agrarian crisis. The average investment per acre of land was about Rs. 11700/- the average value of the crop produce per acre of land was about Rs. 18800/-

The average incomes of farmers used to be about Rs. 7100/- per acre of land. The investments for irrigated land used to be about Rs 11700/- and the produce out of one acre of land used to worth of a value of Rs. 18800/- but in the case of farmers growing rainfed corps and not owing any tube well to get still lesser income.

Interventions

The scenario in the village was fast deteriorating. The farmers who did not own tube wells have almost decided to quit farming as rains have become erratic in onset, distribution, withdrawal, and erratic with down pours and long dry spells at wrong times. The farmers who owned tube wells have started realizing that the competitive digging bore wells and pumping out water for irrigation by individuals would soon end up in depletion of ground water resources, lowering of water table and drying up of aquifer zones in the fields. All the farmers have come together and started discussing to find solutions to their water woes as they feared that very soon in the future all the tube wells in the villages may dry up and results in acute shortage of water, and may cause distress and misery to all villagers. All the farmers have started worrying for their own survival and realized that they need to thank in new ways and evolve sustainable solutions to address this water scarcity issues earnestly. Thus came the thought that they need to join hands, help each other by sharing ground water to sustain their crops and their lives. Thus sharing ground water and evolving appropriate mechanisms and procedures to share water has become a ‘do or die’ option for all villagers.

All these farmers' discourses and discussions were monitored by local NGOs called '*Annadata'* which is a member of and guided by WASSON (watershed support services and action by network) groups. NGOs working at state level. Another NGOs working at the state level, CWS (Centre for World Solidarity) was also working.

Farmers were appraised of in various group meetings that they need to understand and make thumb rules of the fallowing ever truthful ground realities:

1. Water is always scarce and need to be used judiciously in a conservative manner.
2. Rainwater is the god sent source of water for all villagers in dryland areas and we need to conserve every drop of rain.
3. Water is a common property, especially that falls from skies and that gets stored in ground water reserve. Everyone has equal right on ground water.
4. Competitive digging of tube wells and pumping out excessive water for growing crops with water demand is not only a wastage with but also suicidal in the long run.

With these ground values well ingrained in the minds of all villagers, farmers have organised themselves into a group by putting reserve funds as capital in a bank account and registered their societies.

A water user group *'Kolugunti Ummadi Neeti Yajamanya Sangham'* (Kolugunti Joint Water Management Society)

A farmers' group was formed with 25 famers with 15 farmers owning eight bore wells and few farmers not having any bore wells and this group was named *'Kolugunti Ummadi Neeti Yajamanya Sangham'* (Kolugunti Joint Water Management Society). This water users group formulated some guidelines and instructions for smooth networking of farmers and functioning of the group.

The rules for functioning of the society are laid down as under

1. All the farmer members of the group are treated as equal irrespective of the water management society.
2. A joint bank account should be opened in the names of representatives of the water management society
3. Contribution of share capital should be equal from all the farmer members whether they own or not any bore wells.
4. For efficiently running the water sharing network and using the micro-irrigation system for all members, repair and maintenance costs should be collected on the basis of acres of land owned by the members at the rate of Rs. 100 per acre per month. This money is handled by one farmer who has been unanimously chosen by the members of the water sharing society of the village. During the critical irrigation stages in crops, this common fund shall be used for repair and maintenance of bore wells and micro irrigation system.
5. Are under irrigation among the farmers need to be fixed every season depending upon the availability of water in the bore well which is measured on the last day of every month. Area under irrigation should not be increased.
6. In critically irrigated areas, water from bore wells should be provided for at least three crop-growth stages out of the four stages: sowing time, flowering stage, pod development (for ground nut crop) and at harvesting time.
7. At the beginning of every crop season, after measuring the amount ground water (using a long measuring tape) in the bore well crop-water budgeting should be done through discussion and decision making in a participatory approach.
8. Only micro-irrigation system should be used by all members through pipe lines, drip and sprinkler system, in order to conserve water and not to waste it at all.
9. No new tube wells should be dug for 10 years without the permission of water sharing society.
10. All the member farmers of water sharing group should take active part in the meetings, discussions and efficient functioning of the water sharing network.
11. Among the members of the water sharing group-Kolugunti Joint Water Management Society, there were 92 percent marginal farmers out of which 56 percent were sub-marginal (with 1 acre of land) farmers and the rest 36 percent were marginal farmers (with 2 acre of land).

When the uncertainty of water availability is removed from their lives through assurance got from all members that lifesaving irrigation for their crops, farmers vowed to revive their agro-ecosystem and learn and use all the water management practices.

Through government support, water pipelines were laid across all the fields of the member farmers with 75 percent subsidy. Thus micro-irrigation system was laid out to use water conservatively. Next for collecting rain water soil conservation structures were repaired. With respect to conservation agronomic practices all the farmers were asked to do regular weeding, apply soil mulching to reduce loss of valuable soil moisture.

Water sharing groups conducted meetings of their group's members regularly every month to discuss the new ways of water conservation and increasing ground water reserves. Gradually the water levels increased, cropping pattern changed and farmers have become alert and awakened.

Impact of social regulation on water sharing

Once the farmers have agreed upon these five conditions, they have strictly followed them and they were able to get a good crop of groundnut and no one reported any crop losses due to lack of water. Water was shared among the farmers without any troubles or fights. Since new bore wells were not dug up, and since water was not wasted, and rain water was harvested properly by all farmers, recharging of lower aquifers was made possible and they were able to get water throughout the crop season. All the villagers were happy for being able to come together and solve their water scarcity problems amicable through collective action and social regulation.

Impact on Cropping Pattern and returns from farming

Prior to ground water sharing groups, these dryland farmers used to grow only ground nut as a rainfed crop, because most of them do not have any irrigation facility.

But after the formation and successfully running of water sharing group in the village, a new scenario emerged in which there is assured supply of protective irrigation water, through micro-irrigation systems they started growing new crops including pigeon pea, sorghum, tomato and mango plantation in addition to growing groundnut. Some farmers have started growing mulberry, paddy, castor, chrysanthemum and micro-irrigated their mango plantations. Their incomes have risen and the value of their crop produce can be seen in Table 4.

Table 4: Impact of water sharing group on economic returns of crops earned by farmers after initiation of water budgeting and water sharing

S. No	Crops and cropping pattern	Investment (In Rs.)	Value of Produce (In Rs.)	Profit (In Rs.)
1.	Pigeon pea (Red gram)	5080	13,600	8,520
2.	Mulberry	19,400	38,400	19,000
3.	Groundnut, Pigeon pea, Sorghum (Jowar)	9,540	23,550	14,010
4.	Groundnut, Sorghum, Tomato	9,720	64,100	54,380
5.	Paddy, Groundnut, Chrysanthemum	12,820	18,840	6,020
6.	Groundnut, Pigeon pea, Sorghum, Castor, Mango plantation	10,230	22,800	12,570
7.	Mulberry, Groundnut, Pigeon pea, Sorghum	15,280	38,900	23,620
8.	Paddy, Mango plantations	10,900	25,500	14,600
9.	Groundnut, Pigeon pea, Sorghum, Mango Plantations	5,770	11780	6,010
10.	Groundnut, Pigeon pea, Sorghum, Castor	12,290	26,000	13,710

Now the water sharing group was still working and continue to serve the group's member farmers in a sustained manner. Farmers' hopes have got livened and future plans of more collective actions were envisaged.

Conclusion

1. Farmers living in the village Kumaravandlapalli had seen the vagaries of monsoon, crop failure and over exploitation of ground water resources, psychological distress and misery. They began discussions and thought collectively to find any solutions.
2. Intervention of the NGO *Annadata* happened at the most opportune time and their staff started mobilizing people for group actions. At first farmers were skeptical, hesitant and reluctant to join hands. Through several meetings and discussions, farmers were appraised of the changes happening in the village due to global climate change and rains becoming quire unpredictable and erratic.
3. But once the water sharing group got initiated results got realised in the first crop season itself with assured crop harvests for every member family. Farmers could get lifesaving irrigation at critical stages of crop. They were saved from worries and misery and were quite happy as all the farmers could fetch good returns from farming.
4. With adequate storage of water and assurance from the water sharing society they have gradually moved onto better paying and yet water saving crop choices to get better income.
5. Farmers have started appreciating the value of rain water, promoted water harvesting in the village through collecting water in tanks, increasing percolation of rain water through digging deep trenches across the slope of their lands, summer ploughing to keep the fields ready for water absorption and percolation reducing run off and erosion of top fertile soil.
6. All the farmers have adopted all the necessary water saving practices like water harvesting, water storage, recharging aquifers, soil moisture conservation through agronomic practices like inter-culture, mulching, weeding, soil fertility enhancement through crop residue incorporation, application of FYM and organic matter.

Acknowledgement

Authors are thankful to farmers particularly DHARMA REDDY Garu and Dr. D.U.M. Rao Principal scientist in the division of agriculture extension ICAR-IARI for their support during the data collection and conducting this study successfully. First author is thankful to Indian council of agricultural research for providing the financial assistance in the form of Junior Research Fellowship to carry out the research.

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