Water and Livelihoods: Role of Collective Action and Property Rights (A Case of Surface and Groundwater Management in India)

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Abstract

Property rights over natural resources are fundamental in shaping the livelihoods of rural poor. Rural poor are often found to possess the weakest property rights over resources, such as land, water, forests, etc. By re-contracting rights in different ways, disadvantaged actors may create opportunities to amend their initial disadvantages into a more beneficial arrangement for them. Most of the poor find themselves in poverty not due to the absence of property rights, but due to their inability to assert or change them through collective action. In most of the cases the existing property rights that are embedded in political-economy systems are biased against poor. Hence, collective action or social mobilisation is an important channel for asserting the rights of the poor.

The effectiveness of collective action in overcoming the socio-economic and political dynamics depends on the relative strength of the collective group in changing the political fortunes. In the absence of such strengths collective action may not necessarily guarantee success with respect to poverty alleviation. As long as socioeconomic inequities and 'elite capture' are dominant phenomena in the system, institutional changes (including property rights) may not result in poverty alleviation. Though, water and livelihoods are closely associated the linkages weaken in the absence property rights. Collective action could help reworking the rights but their linkages under divergent conditions are less understood. This paper is an attempt to understand the intricacies in the relations between property rights, collective action and livelihoods. Water management, surface as well as ground water, in Andhra Pradesh, India forms the backdrop for understanding the complexities.

This paper argues that the importance and strengths of property rights and collective action depends on the nature and type of property rights regime the resource is operating under. Existing property rights are often found to be biased against the poor. This is mainly due to the absence of equity concerns in the existing property rights. As a result these property rights are not effective in addressing the issues of poverty. While collective action could initiate changes in property rights regimes, incorporating the equity issues in to property rights involves transaction costs. On the other hand, equity based property rights facilitate collective action strategies. Equity appears to be the critical factor in determining the effectiveness of collective action and property rights in addressing poverty.

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I Introduction

Property rights over natural resources are fundamental in shaping the livelihoods of rural poor. Rural poor are often found to possess the weakest property rights over resources, such as land, water, trees, livestock, fish, genetic resources, etc. Although property rights are necessary and relevant in many circumstances, they alone may not result in poverty alleviation (Fakir, 2004; Mwangi, 2004). That is, property rights are necessary but not sufficient for poverty alleviation. Other resources (credit, human skills, infrastructure, markets, etc) are needed to complement the rights in resources that one requires to make sound investment decisions for overcoming poverty. By re-contracting rights in different ways, disadvantaged actors may create opportunities to amend their initial disadvantages into a more beneficial arrangement for them. However, who loses and who gains depends on the type of resource and the nature of changes in property rights i.e., moving from individual to group or vice versa (Reddy, 2000).

Most of the poor find themselves in poverty not due to the absence of property rights, but due to their inability to assert or change them through collective action. In most of the cases the existing property rights that are embedded in political-economy systems are biased against poor. Hence, collective action or social mobilisation is an important channel for asserting the rights of the poor. Collective action to assert or change the property rights in resources or assets is complex and costly, as it threatens the existing socio-economic and political structures. The effectiveness of collective action in overcoming the socio-economic and political dynamics depends on the relative strength of the collective group in changing the political fortunes. In the absence of such strengths collective action may not necessarily guarantee success with respect to poverty alleviation. As long as socioeconomic inequities and 'elite capture' are dominant phenomena in the system, institutional changes (including property rights) may not result in poverty alleviation irrespective of the fact that these changes happen due to new ideas (Bromely, 2005) or due to social justice concerns (Birner, 2004).

Though, there is consensus regarding the role and importance of property rights and collective action in poverty alleviation, their importance, effectiveness and relative strengths in varying resource, socio-economic and political situations is less understood. Besides, there is no clarity regarding the linkages or synergy between property rights and collective action. These two are often treated as mutually exclusive rather than mutually inclusive or complementary. How necessary and sufficient the conditions of property rights and collective action in poverty alleviation? Can either of them or both of them ameliorate poverty? If so, under what socio-economic and political situations? This paper is an attempt to understand the intricacies in the relations between property rights, collective action and poverty alleviation. Water resource management in Andhra Pradesh, India forms the backdrop for understanding the complexities. Water resource management epitomizes the interplay of property rights, collective action and poverty alleviation.

II Concepts and Linkages

Here the concepts of poverty, collective action and property rights are defined in a manner to suit the water context. Poverty is defined in a comprehensive manner instead of limiting to income poverty. As per the Human Rights office of the UN poverty is defined as: "a human condition characterized by the sustained or chronic deprivation of the resources, capabilities, choices, security and power necessary for the enjoyment of an adequate standard of living and other civil, cultural, economic, political, and social rights" (Di Gregorio, et. al., 2004). Although management regimes differentiate between open access and other forms of property rights when addressed together they are termed as common pool resources (CPRs). CPRs are defined as natural or manmade resources with attributes of nonexclusion (large enough to exclude other users costlessly or with low costs) and subtractability (consumption of the resource by one user will reduce its availability to others) (Ostrom, Gardner and Walker, 1994; Singh, 1994). Surface and groundwater water are common pool resources[3].

Collective action is defined as "an action taken by a group of individuals to achieve common interests (Marshall, 1998, as quoted in Di Gregorio, et. al., 2004). Often participation is used synonymously with collective action. There could be varying modes of participation such as, nominal, passive, consultative, activity specific, active, interactive and informed (Aggarwal, 2001 and GoI, 2006)[4]. All these forms of participation do not result in collective action as defined above. Mere contribution by members does not merit collective action. Participation could be equated with collective action as long as 'individual costs of participation are more than that of individual benefits'. That is there is an amount of 'voluntary involvement and efforts for the sake of achieving a common good'. Collective action institutions are understood as regularised patterns of behaviour between individuals and groups in society, or complexes of norms, rules and behaviours that serve a collective purpose (de Janvry, 1993, p.556). These institutions could be formal or informal (for a detailed discussion see Reddy, 1998). The institutions created for canal water management in AP are purely formal.

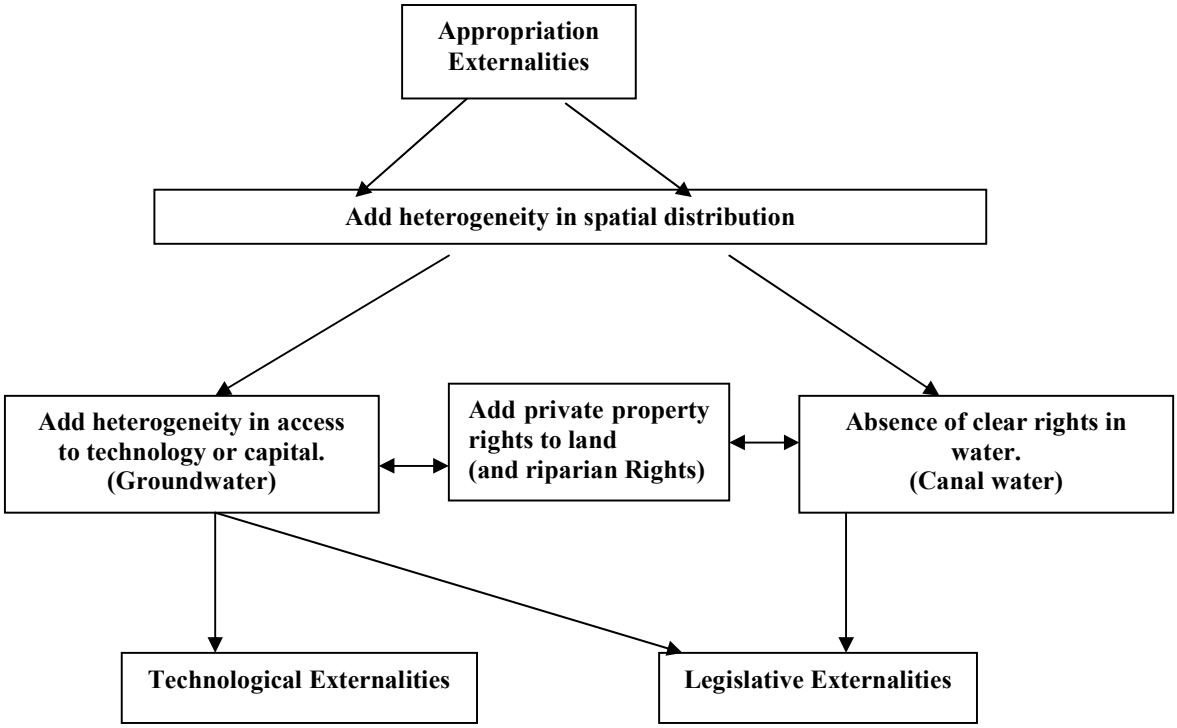
An efficient system of property rights should have three features: i) universality, ii) exclusivity, and iii) transferability (Posner, 1977 as quoted in Bromley, 1989a). It is argued that individuals, rather than community, would be in a better position to allocate resources more efficiently and maximise societal returns. Property rights are developed

[3] As per the easement act of 1882 groundwater rights are customarily attached to land ownership, hence groundwater management is totally left to the private initiatives. Given the linkages between surface and subsurface water bodies the property rights are rather blurred in the case of groundwater. As a result, groundwater management becomes a stumbling block in addressing or resolving the equity, property rights and collective action dilemmas.

[4] The characteristics of these modes include: nominal= Membership of groups with or without payment; passive= silent participation in meetings or getting information on decisions after the meetings; consultative= being asked for opinions without necessarily being able to influence decisions; Active-specific= volunteering to undertake specific tasks; active= pro-actively expressing view, taking other initiatives; interactive (empowering)= with voice and influence on decisions; and informed (empowered)= being able to take into account information and opinions of external agents (experts) and make considered decisions.

to internalise externalities when the gains of internalisation becomes greater than the cost of internalisation (Demsetz, 1967, quoted in Baland and Platteau 1996). Though it sounds logical that clearly specified property rights lead to better and efficient allocation of resources, individual property rights approach has some important drawbacks. First, it may not lead to an efficient allocation of resources due to the existing imperfections in capital and labour markets. Second, uneven distribution of rights would increase the ecological stress on the land if the majority of poor farmers were allotted rights in marginal and degraded lands (Gans, 1989). Besides, it would aggravate the existing inequalities due to the inequitable distribution of resources attached to land, such as groundwater. On the other hand, in the absence of equitable rights in the resource as in the case of canal water could perpetuate inequalities and poverty. Distribution of such rights may be (dis) advantageous to certain households due to their locational (dis) advantageous.

Figure 1: Property Rights in the Context of Externalities



Heterogeneity in spatial distribution of groundwater creates the problem of assignment. But it involves a further complication as land (under which groundwater lies) rights are privately owned. The intertwining of private and common resources results in further externalities, which can be termed as *legislative externalities* (Figure 1). Legislative externalities arise when there is no clear-cut legislation demarcating and protecting different property regimes. While groundwater is a CPR in which rights are limited to use and income deriving, it is also sold and transferred along with land due to its link with land. But, legislation is not clear in specifying how groundwater should be managed

judiciously and distributed equitably. As a result, farmers make private investment thinking that they have absolute rights to a groundwater basin beneath their land. Similarly, differences in spatial distribution of canal water between head and tail reaches results in exclusion of tail-end communities (assignment problems). Canal waters are treated as common pool resources, but the benefits are often reaped by the head reach locations disproportionately due to lack of clearly defined property rights in water. As a result, tail enders have no incentive to join the collective efforts. Often majority of the poor (marginal and small farmers) are located in the tail reaches while the rich (large farmers) own lands in the head reaches. These situations arise not only due to the nature of the resource but also due to the existing institutional arrangements.

The Linkages

The dynamics and interactions between four aspects viz., resource vulnerability, social, economic and political structures, determine the evolution and effectiveness of property rights and collective action institutions at the community or village level (Fig. 2). The relationship between property rights and collective action is neither automatic nor consistent. The linkages between these two depend on the nature of the resource and existing or accepted property rights. Collective action can lead to establishment or changes in the existing property rights. On the other hand, new property rights regimes may also create the environment for collective action. But, collective action may not take place if there are conflicting interests in the community. More importantly it depends on the strength (socio-economic and political) of the losing group (Reddy, 1999).

With the establishment of well-defined community property rights, groundwater can be converted into a common resource *de jury* as well as *de facto*. Collective action arrangements could help in managing groundwater on a community basis. Presently only rich farmers are having access to groundwater due to the availability of groundwater aquifers at greater depth, which is increasing over the years. While majority of the farmers (small and marginal) is showing interest in groundwater management on a community basis with little help from government, large farmers' prefer the present system of private management (Table 1). The persistence of diagonally opposite perceptions between present and future beneficiaries makes the promotion of collective action and making it effective an onerous task. Same groups react differently in the case of canal water. Tail end farmers (often poor) demand private property rights (full fledged) in canal water so that they can get a legitimate share in the respective resource. Head reach (often rich) farmers support the present arrangement of treating it as a common resource with unequal (even riparian) rights in water. These perceptions reflect the variations in access and availability of the resource to the respective groups.

Figure 2: Linkages between Property Rights and Collective Action for Poverty Alleviation.

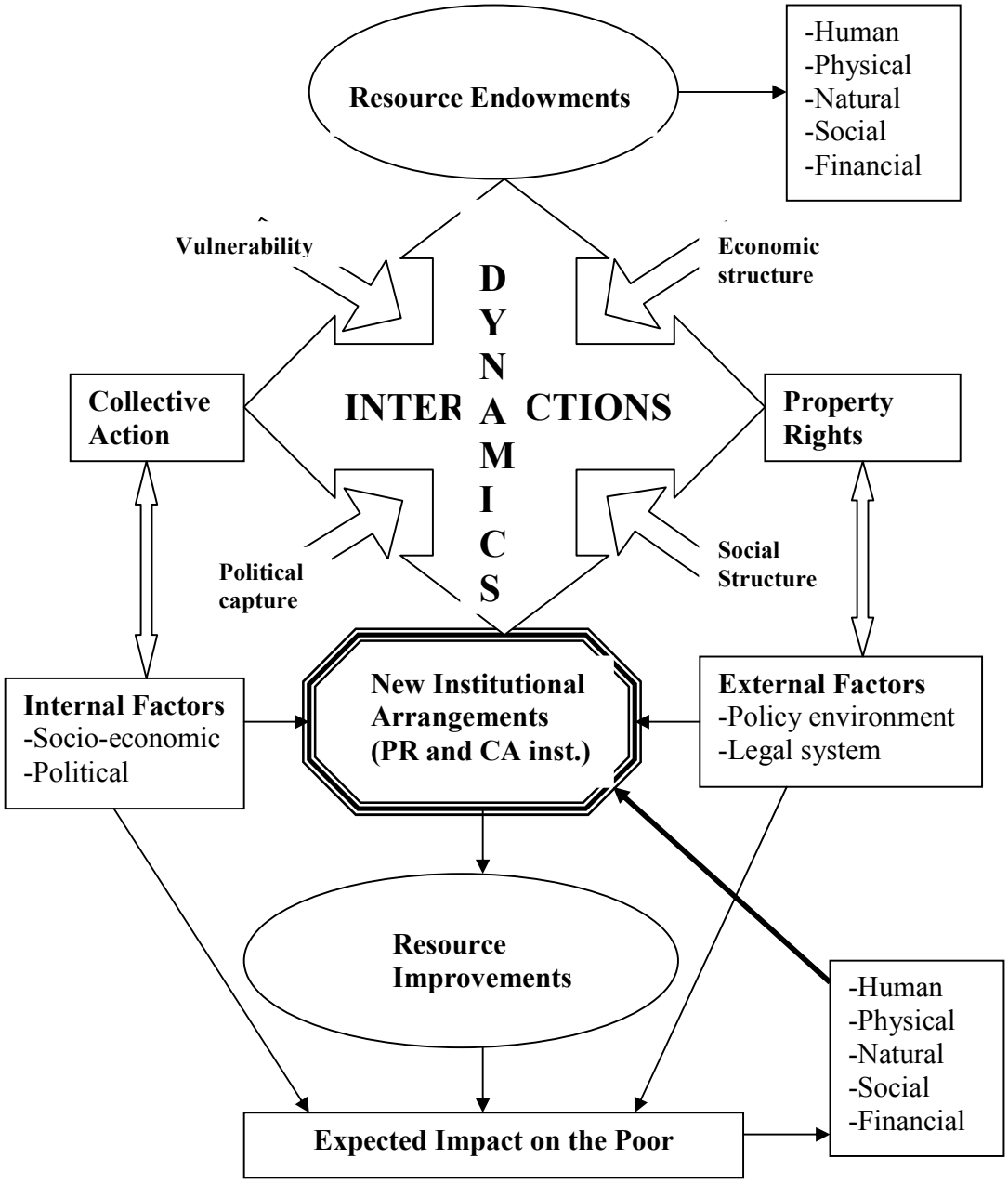


Table 1: Perceptions about Property Rights in Commons

Groundwater		**Canal Water**	
Present Beneficiaries (Large Farmers)	Future Beneficiaries (Small Farmers)	Present Beneficiaries (Head reaches / Large Farmers)	Future Beneficiaries (Tail reaches / Marginal & Small Farmers)
Private Property rights (status quo)	Community based property rights. (change through Collective action)	Community based property rights (status quo)	Clearly defined and Equal rights (change through legal action)

Source: Adopted from Reddy (1999).

In both the cases, the existing property rights are biased against the poor. The reason being that the existing property rights do not address the equity issues. As a result, short-term individual economic interests cloud over the long term social or community interests. Here there is a clear dichotomy as far as the linkages between property rights and collective action are concerned. In the case of groundwater collective action is a prerequisite to change and enforce a system of community based property rights, while in the case of canal water clearly defined and equitable private property rights are required in place of the existing community oriented allocations. In both the cases poor tend to benefit if changes in rights are enforced. Incorporation of equity principles in to the management of canal water through appropriate institutional, incentive /disincentive structures could help in promoting collective strategies. Bringing the equity concerns to the centre stage is the crux of the problem. Equity can't be brought in mechanically or imposed, as it is linked to numerous factors[5]. These include changes in economic structure, policy and legal support systems. Poor are keen to change the existing property rights and ready to act collectively. But the existing socio-economic and political structures constrain them from doing so, despite the fact that they are in majority.

What causes collective action and changes in property rights is difficult to pinpoint? They are intricately linked. In some cases it is the internal factors like political leadership or existing socio-economic conditions that prompt collective action, while in others external forces like changes in policy and legal structures impose or ignite collective action that could alter the internal factors. Similarly, successful resource management strategies, prompted by individuals or NGOs, could lead to policy changes and legal provisions[6]. The new institutional arrangements with any improvement over the existing ones would lead to resource improvements. These improvements could have an impact

[5] Due to this reason we have not introduced equity as an explicit factor in figure 2.

[6] A case in point is the 1994 watershed guidelines, which has incorporated number of principles that were in practice in successful watersheds across the country (GoI, 1994). Similarly, the proposed Neeranchal guidelines (GoI, 2006) have addressed the concerns arise from the implementation of the earlier Haryali guidelines (GoI, 2003).

on poverty provided the changes incorporate the equity concerns effectively. In fact, the reduction in poverty would help in sustaining the new regimes of collective action and property rights arrangements. While the expected impacts on poor are influenced by the external and internal, especially structural factors, the expectations on the part of poor also help in evolving new property rights regimes and collective action strategies. Poor would have incentive to participate if their expected benefits are positive and substantial.

Thus, collective action and property rights though are necessary but not sufficient to alleviate poverty as long as equity concerns are not integrated. In the absence of equity collective action strategies always tend to be a 'zero sum' game, as the existing socio-economic and political structure always go against the poor. While collective action appears to be the most needed to bring in equity in the case of certain resources like water with out changing the existing property rights. Equity issues can be integrated in to the existing collective action strategies with out altering the property rights regime. But, in both the cases there is need for broader consensus involving all the stakeholders (entire community). Changes in property rights regimes (individual or community) should be resource specific. Collective action and property rights are closely linked, but their order of importance (which is necessary and which is sufficient condition?) depends on the type of resources and the nature of existing property rights. The high transaction costs involved in addressing the equity issues in property rights deter the required changes, thus allowing the persistence of inefficient property rights regimes (Libecap, 2002). Some of these dimensions are explored in the context of water management institutions in Andhra Pradesh, India. Though our analysis is limited to one state, the framework and the experience of water management could be generalised as the situation, policy and implementation levels, is similar in most parts of India.

III Managing Water: The Experience

This section is based on the data collected at two levels i.e., WUA level and household level[7]. At the first level, a sample of 222 WUAs was selected from 22 districts (10 WUAs in each district) in the State. A detailed WUA schedule was canvassed among these 222 WUAs in order to examine their structure and functioning. At the intensive level a sample of 6 WUAs representing the three agro-climate regions of the State viz, Coastal Andhra, Rayalaseema and Telangana regions were selected. The selection was purposive to cover the canal and tank systems, though the selection of districts was based on the concentration of WUAs in each category (canal and tank). From each WUA a sample of fifty farmers, representing head-middle-tail ends of the distributory systems and different socio-economic sections of the community was drawn using the probability proportionate sampling method for an in-depth survey. In all 300 farmers were studied intensively using the survey method with the help of a detailed household level schedule. Prior to the sample survey Participatory Rural Appraisal (PRA) exercises were conducted in the sample villages in order to draw qualitative inferences about the village community. PRA was also helpful in designing the questionnaire. Besides, focus

[7] The data was collected in connection with the project titled: Formalising Irrigation Institutions: A Study of Water User Associations in Andhra Pradesh",. Financial support from National Agricultural Technology Project Through the World Bank and NCEAR, New Delhi is gratefully acknowledged.

group interviews were held with the office bearers of the WUAs and irrigation department officials. Here we have restricted our analysis to canal irrigation only covering 150 households in three districts of coastal Andhra and Telangana (Khammam, Nalgonda and East Godavari). The analysis also draws from another study on groundwater in Andhra Pradesh[8]. Here also the data was elicited at the household level using well irrigation. Data was drawn from 417 well owners (census) in three villages of Warangal (Telangana) district. Further, intensive data was collected from a sample of 75 households (25 from each village) in the three villages. The main focus here is to examine the equity aspects of water management institutions in canal (WUAs) and groundwater, which is managed as private property.

Canal Water

The A. P. Farmers' Management of Irrigation Systems Act was enacted in 1997. Under this act, 10,292 Water User Associations (WUAs) had been registered. Elections were conducted in June 1997 for all WUAs under major, medium and minor schemes. In November 1997, elections to the distributory committees were also completed. It was proposed (1997) that project level committees would also be constituted soon in order to effect total transfer of management to the farmers' organisations. The main objectives of the act include: i) realising the maximum irrigation potential, ii) ensuring equitable and reliable supplies, iii) improving the efficiency of the existing irrigation network, and iv) managing water resources through stakeholder participation and withdraw the department from O & M (For details see Reddy, et. al, 2005).

WUAs are the primary structures of irrigation water users. Number of WUAs under each scheme depends on the size of the irrigation scheme, which ranges from one to a few hundreds of WUAs across the schemes. The main role of WUAs is to regulate and distribute water within its command area. The election procedure of the WUAs has been changed during 2003. According to the new procedure: There are twelve territorial WU constituencies in each of the WUA of Major and medium irrigation systems. Every WUAs shall consist of the following members:

- All the water users who are land holders in water users area,
- All other water users co-opted in a water user area,
- Members specified above shall constitute the general body for a WUA.

There shall be a Managing Committee (MC) for each WUA, comprising members of the Territorial Constituencies (TCs) elected directly by the water users from their respective TCs. The MC shall be a continuous body, with one third of its members retiring every two years. The term of the office of the members of the TCs is expected to be six years from the date of first meeting of the MC (Provided that at the first election, all the TC members shall be elected at one time, out of which, one third of the members thereof shall retire after completion of two years, another one third members are expected to

[8] The study is part of a major study on "Environmental degradation: Case, market, Institutional and Policy Failure". The project was supported by the India: Environmental capacity Building Project funded by the World Bank through IGIDR, Mumbai.

retire after completion of four years, and the remaining one third shall retire after completion of six years in office (terms of retirement shall be decided by drawl of lots).

An ordinary election is to be held for the purpose of constituting WUAs in major and medium irrigation systems. The election of TC members, President and the vice-president of the WUA may be either through rising of hands or through voting slips. The president and the vice-president of the managing committee of water users association shall, if not recalled or removed or disqualified by the provisions of the Act, be in office for a period of two years from the date of election or his tenure as member of territorial constituency, which ever is earlier.

Functions of these bodies include preparation of operational plans at the beginning of each season, maintain an inventory of irrigation systems such as tanks, ponds, wells, etc., within the command area, maintenance of records, plan and execute the distributory and drainage systems maintenance, water budgeting, resource mobilisation, conflict resolution, etc. One interesting feature of the WUAs is the right to recall the president if his functioning is not satisfactory. The general body can remove him with one-third majority. However, the institutional structure misses out on some important aspects that are necessary for the success and sustainability of the institutions. All the rights in WUAs are given to land owning and tenant cultivators to the neglect of land less and other water users such as land less women, fishermen, etc. This denies equitable access to a common pool resource. Similarly, there is no provision for equitable distribution of water across locations (head, middle and tail) in the distributory systems. As a result, the huge public investments in this sector benefit only sections of the community due to their locational advantage. Equal distribution of water rights is seen as vital for sustaining water institutions (Deshpande and Reddy, 1990).

Impact of WUAs

Better and equitable water delivery / distribution is one of the main objectives of the WUAs. It is also an important indicator of the efficient functioning of any WUA. Water delivery performance and distribution can be estimated on the basis of area irrigated, number of waterings and crop productivity (here paddy, the main irrigated crop). Between 1997-98 and 2001-02 there has been an increase in the average area irrigated of the sample households in the canal systems. But, the severe drought in 2002-03 has adversely affected the area irrigated. Between 1997-98 and 2001-02 the increase in area irrigated is more in the case of middle reaches when compared to head and tail reaches. While head reaches were not facing any water shortages prior to the advent of WUAs, water avaibility was marginal in the tail end locations. Marginal changes in area irrigated in the tail ends indicate that WUAs have provided little relief to these areas that were suffering water shortages prior to the advent of WUAs (Table 2). And tails ends were the worst affected during the drought year (2002-03).

Table 2: Changes in Area Irrigated (in percentages) between 1997-98 and 2001-2002 by Location

	Canal		
Year	**Head**	**Middle**	**Tail**
1997-98	3.81	4.01	2.61
1998-99	3.73	4.06	3.54
1999-00	3.89	4.16	2.79
2000-01	3.93	4.11	2.78
2001-02	3.88	4.21	2.69
2002-03	1.31	2.31	0.57

Source: Survey data

Table 3: Water Requirement and Availability for Paddy during the period 1997-98 to 2002-2003.

Water Distribution	**Canal**		
	Head	**Middle**	**Tail**
1997-98			
No. of Watering Requirements	105	105	103
No. of actual Watering	104	103	99
1998-99			
No. of Watering Requirements	108	105	105
No. of actual Watering	105	103	98
1999-2000			
No. of Watering Requirements	107	107	100
No. of actual Watering	105	105	94
2000-2001			
No. of Watering Requirements	107	105	105
No. of actual Watering	105	105	104
2001-2002			
No. of Watering Requirements	105	105	105
No. of actual Watering	105	105	102

The adequacy of water reaching the farmers at the end of the canal i.e., the number of days that sufficient water reached to the tail reaches of the canal is measured in terms of number of actual waterings in comparison with water requirement. The analysis from the sample WUAs indicated that there are differences in the number of irrigations required and actual number of waterings for paddy. The gap between required and

actual irrigations is more in the tail end reaches. While the actual waterings are consistent at the head reaches, they go down as we move from head to tail reaches. The decline is more in the tail ends, especially during drought years (Table 3). Though there was a reduction in the gap between required and actual over the years even in the tail end reaches, the problem of scarcity continues in the critical years of drought or poor rainfall.

The economic composition of the farmers across locations clearly indicates that majority of the marginal and small farmers are located at tail ends when compared to medium and large farmers (Table 4). Marginal and small farmers have less area irrigated (absolute terms) and earn less income per year per household. Average annual income of marginal farmers is a quarter of the annual income of large farmers. More importantly, marginal and small farmers dependency on crop production is more when compared to medium and large farmers (Table 5). This makes their livelihoods vulnerable to water scarcity. Being the tail enders they tend to face water shortages more often, apart from getting less than required water even in normal years.

Table 4: Distribution of Households and Their Annual Income Across Locations

	Percentage of Households			**Area Irrigated**			**Average annual income/HH**		
	Head	**Middle**	**Tail**	**Head**	**Middle**	**Tail**	**Head**	**Middle**	**Tail**
MARGINAL	32	17	51	1.46	1.46	1.57	27208	23653	18186
SMALL	37	24	39	3.33	2.82	3.18	31714	24333	29200
MEDIUM	43	35	22	6.10	6.75	5.92	51250	78250	40300
LARGE	39	28	33	15.39	12.00	14.87	98357	82600	70166
ALL SIZES	35	23	42	4.55	4.53	3.54	41781	44728	27368

Table 5: Dependency on Crop Production

	Head	**Middle**	**Tail**
MARGINAL	22	12	37
SMALL	14	09	15
MEDIUM	10	08	04
LARGE	07	05	06
ALL SIZES	53	34	62

The ‘elite capture’ of parallel institutions is attributed mainly to: a) elite are not able to get into Panchayat Raj bodies due to reservation policy and, b) parallel institutions are financially stronger than the PRIs. The main idea of initiating WUAs in A P, is that these

institutions would be apolitical and focus on delivery. Though elections were not conducted in their true spirit in majority of the cases, political interference is observed in a substantial number of cases. Though regular conduction of elections may go against the basic philosophy of participatory development and management through political divide, the nomination process facilitates 'elite capture'. As a result, these institutions in their present form tend to dilute the social capital rather than strengthening it.

Table 6: Socio-economic Composition of WUA Executive Members in Canal and Tank WUAs

Caste	Canal			Tank		
	President	Members	% to population	President	Members	% to population
Social Composition (%)						
SC/ST	01	11	10	04	14	12
BC	11	32	30	43	54	52
OC	88	57	60	53	32	36
Economic Composition (%)						
0.10-2.50	03	12	11	19	31	29
2.51-5.00	09	30	27	25	27	27
5.10-10.0	49	42	43	30	26	26
10.1&above	39	16	19	26	16	18
All	100 (1.2)	100 (0.1)	100	100 (1.4)	100 (2.5)	100

Note: Figures in brackets are proportion of females in the respective category.

The fallout of 'elite capture' is reflected in the absence of commitment and ownership among farmers in the maintenance of the systems. Farmer's involvement is limited to participation in elections, attending general body meetings (conducted only once) and to some extent water distribution. Their involvement in the important works like rehabilitation and resettlement and joint assessment survey is found to be marginal (Reddy, et. al, 2005). In the case of canal systems, less than 20 percent of the farmers contributed to the maintenance works, either in cash or kind. Interestingly, more people contributed in the head reaches when compared to middle and tail reaches though the differences are marginal. The reasons for lack of contribution include: a) no demand, b) lack of money and c) nobody were contributing. Regarding the maintenance works, majority of them are not satisfied. Low availability of water in the tail reaches is also reflected in the quality of works carried out. Over all less than a quarter of the works are observed to be of good quality. The quality of works declines as one move from head to tail reaches. Political interference appears to be the major demerit of the WUAs, especially in the context of work allocations and work quality.

Though some benefits in terms of increased area under irrigation in canal systems and improved quality of irrigation is evident, the sustainability of these benefits is rather

uncertain in the absence of efficient institutional structures. While it appears that an opportunity to build stronger and sustainable irrigation institutions is floundered, the opportunity is not totally lost, as the WUAs are still in place. It is observed that formal institutions are rigid and rule bound[9]. Equity in the management and distribution of water is not addressed. No proper incentive (positive and negative) structures were designed and placed to support rule compliance.

Groundwater[10]

Groundwater is the single largest source of irrigation in AP as well as in India. Despite its importance, it is the most mismanaged resource. Groundwater development in Andhra Pradesh is about 42 percent leaving apparently a large potential for future development[11]. At present there are 22.23 lakh wells in the state. Of which 13.36 lakhs in Telangana, 4.71 lakhs in Rayalaseema and 4.16 lakhs in Coastal Andhra regions. Further, 11.46 lakh wells are estimated to be feasible with a distribution of 3.89, 1.38 and 6.19 lakh wells in the respective regions (with groundwater development of 85 per cent). It is clear that the potential for well irrigation is limited in Rayalaseema, as groundwater development in this region has crossed 50 per cent. Similarly, Telangana has also limited potential. Between 1975 and 1999 well population increased from 8.20 lakhs to 22.22 lakhs, while the area increased from 10 lakh hectares to 26.44 lakh hectares. Despite the advent of new technologies in water lifting in recent years area irrigated per well has gone down marginally from 1.22 to 1.19 indicating declining water yields. Decline in area per well is higher in Rayalaseema followed by Coastal Andhra region whereas Telangana recorded an increase in the area irrigated per well.

Problem seems to be more serious at the local level. For, 62 per cent of the villages in 9 dark mandals in Rayalaseema region fall under dark category due to over exploitation of groundwater. In both Rayaseema and Telangana regions majority of the wells are of 10-20 meter depth. This is reflected in the growth in tube wells in these regions. Well population is increasing at the rate of 56000 wells per year of which 60 per cent is in the Telangana region alone. Given the present low irrigation levels in these regions (Rayalaseema and Telangana) coupled with the absence of any potential canal irrigation possibilities, these regions have to depend more on tank irrigation and improving the groundwater potential through rain water harvesting and percolation tanks. The increased stress on groundwater is clearly reflected in the faster growth of bore wells (compared to dug wells, which are drying up in most of the areas) and the declining area irrigated per well. More over, groundwater irrigation is biased against poor (marginal and small) farmers and they tend to be the first victims of its degradations. The following analysis brings out these dimensions clearly.

[9] For a detailed discussion on formal vis a vis informal institutions see Reddy and Reddy, 2002.
[10] This section draws mainly from Reddy (2002).
[11] It may be noted that all this potential is not utilizable as it includes groundwater resources in inaccessible areas like forest and hilly regions.

Table 7: Distribution of Well Owners by Economic Class and Well Type.

Land Category	Number of Households Having				
	Open Wells	Bore Wells	Both	Total	% of Open wells dried up
Vanaparthy [700]	43	100	9	152 (22)	45
Large Farmers [77]	13	37	7	57 (74)	48
Medium Farmers [175]	5	42	1	48 (27)	71
Small Farmers [203]	13	17	1	31 (15)	28
Marginal Farmers [224]	12	4	0	16 (07)	15
Teegaram [350]	69	40	21	130 (37)	52
Large Farmers [25]	2	1	4	07 (28)	33
Medium Farmers [50]	27	14	15	56 (37)	26
Small Farmers [119]	21	12	2	35 (29)	59
Marginal Farmers [56]	19	13	0	32 (57)	90
Vaddicherla [800]	19	108	8	135 (17)	85
Large Farmers [72]	2	11	3	16 (22)	69
Medium Farmers [152]	7	28	1	36 (24)	84
Small Farmers [200]	6	41	4	51 (25)	86
Marginal Farmers [328]	4	28	0	32 (10)	90

Note: Figures in [ ] indicate the total number of households. Figures in ( ) indicate the respective percentages to total number of households.
Source: Village Well Census survey.

Development and Distribution
Dependence on groundwater is total in all the sample villages. Sample Villages range from reasonably good availability of groundwater to acute shortages (including drinking water). There are no alternative sources of supply in two of the villages, while in one village an existing tank has been converted in to a percolation tank, where the water situation is much better. In the other villages also there are tanks but fallen to disuse

due to various reasons. Concentration of wells, open as well as bore, is quite high in all the villages. Of late most of the open wells are converted in to bore wells by putting in-well bores, as most of the open wells have dried up and water tables have gone down substantially during the last 5 years.

Table 8: Changes in Well Irrigation During the Last Five Years

Village/size class	Number of wells			Reasons for change (% of farmers)			
	2000-01	1995-96	% change	1	2	3	4
Vanaparthy	32	23	39	44	44	08	28
Large Farmers	3	3	00	67	67	0	67
Medium Farmers	10	5	100	17	17	17	0
Small Farmers	13	10	30	30	30	10	20
Marginal Farmers	6	5	20	83	83	0	0
Teegaram	32	21	52	48	0	16	16
Large Farmers	7	4	75	33	0	0	0
Medium Farmers	7	4	75	43	0	14	28
Small Farmers	12	8	50	70	0	20	10
Marginal Farmers	6	5	20	20	0	20	20
Vaddicherla	37	22	68	56	0	0	28
Large Farmers	15	13	15	44	0	11	44
Medium Farmers	8	3	167	100	0	0	0
Small Farmers	9	3	200	71	0	0	29
Marginal Farmers	5	3	67	20	0	0	20

Note: 1= Groundwater level decreased, Open wells dried-up; 2= Tank converted in to Percolation tank; 3= Neighbour farmers installed bore wells, 4= No other sources are available. Change is due to bore wells only, as the number of open wells declined over the years.
Source: Intensive sample survey.

Development and Degradation
Groundwater situation in the region is changing year after year due to the ever-increasing pressure on the resource. Over the last five years well population (bore wells) in the sample villages has gone up in all the villages. The extent of growth ranges from 39 percent in Vanaparthy to 68 percent in Vaddicherla (Table 8). In all the villages the expansion of well irrigation (number of wells) is mostly on large and medium farmers though small farmers have recorded higher rate of expansion in Vaddicherla. The most important reason, according to the farmers, for the increase is the declining water table and drying up of open wells. In Vanaparthy the expansion is attributed to the conversion of an irrigation tank in to percolation tank in the recent years. The second important

factor is that the natural expansion, as there is no other source of irrigation. While the first reason stems out of the externality problems trigger mechanism does not seem to be an important reason (3) for the expansion. Impact of declining water table and the drying up of open wells is reflected in the changes in the composition of wells over the period. In all the villages there is significant decline (about 60 per cent) in the number of open wells. On the other hand, number of bore wells has increased many folds in all the villages. In majority of the cases small and marginal farmers have resorted to bore wells consequent to the decline in open wells.

Table 9: Changes in Depth of the Wells During the Last Five Years by type of Well

Village/size class	Depth of open wells (in feet)			Depth of Bore wells (in feet)		
	2000-01	1995-96	% change	2000-01	1995-96	% change
Vanaparthy	48	29	67	108	95	13
Large Farmers	40	24	67	120	80	50
Medium Farmers	40	30	33	100	100	100
Small Farmers	45	24	87	100	90	11
Marginal Farmers	65	36	80	110	110	00
Teegaram	50	29	75	133	98	36
Large Farmers	50	24	108	140	90	56
Medium Farmers	50	24	108	150	110	36
Small Farmers	50	30	67	120	100	20
Marginal Farmers	49	36	36	120	90	33
Vaddicherla	50	38	31	150	96	56
Large Farmers	49	36	36	120	85	41
Medium Farmers	50	40	25	150	90	67
Small Farmers	60	40	50	150	100	50
Marginal Farmers	40	36	11	180	110	64

Note: Positive change in depth indicates declining groundwater table. Depth is measured in terms of availability of sufficient water below the ground level, as perceived by the farmers. However, some farmers may go deeper than this keeping long-term interests and affordability.
Source: Intensive sample survey.

Apart from changing composition of the wells depth of wells has increased considerably over the period of five years. Increased depth of wells mean higher capital and running costs. Capital costs increase due to deepening of open wells, conversion of open wells in to in-well bores and replacement of open wells with bore wells. All the open wells have motors with 3 HP while most of the bore wells have 5 HP motors. All the sample villages experienced substantial decline in water levels in open wells during the last five

years (Table 9). While the average depth of open wells is more or less same in all the villages presently, the depth was substantially more in Vaddicherla five years back reflecting the water stress. Since open wells usually do not cross 50-60 feet the average dept has saturated at 50 feet in all the villages. The differences in the depth during the base year have resulted in marginal changes in depth in Vaddicherla. On an average open wells have recorded about 4 feet decline in water table per year in Vanaparthy and Teegaram while it is more than 2 feet in Vaddicherla. The decline is much sharper in the case of bore wells in these two villages. Depth of bore wells declined by 35 feet (7 feet per year) in Teegaram and 55 feet in Vaddicherla (11 feet per year) during the last 5 years. Where as, the decline was only 13 feet (2.5 feet per year) in Vanaparthy. This is mainly attributed to the percolation tank, as most of the bore wells have come up in the vicinity of the tank. It may be noted that as the water stress increases small and marginal farmers tend to go deeper in search of water. For, large farmers could invest in deeper wells even before the scarcity sets in. In the event of scarcity small and marginal farmers are forced to go deeper. Besides, location disadvantage of these farmers adds to their owes. However, this is not true in the case of open wells, which are labour intensive and hence small and marginal farmers are at an advantageous position.

Costs of Degradation

There are number of appropriation (negative) externalities associated with groundwater depletion. These externalities range from decline in area irrigated to drying of trees and desertification. While all these impacts are not observed in the study region, a few of the negative impacts can be quantified in monetary terms. Despite large private investment in groundwater exploitation the area under irrigation declined over the period of five years. Besides, the cropping pattern has shifted away from the more remunerative water intensive paddy crop to other less remunerative dry crops. As a result farmers have incurred net losses that include the direct and indirect costs. Direct costs include the investments made in bore wells and loss of capital due to drying of open wells. These costs may be termed as 'sunk costs' in the case of drying up of open wells and 'replacement costs' in the case of new bore wells that have replaced the old open wells. Direct costs are one time costs and are likely to increase over time along with the drying up of open wells and increase in the number of bore wells. These costs cumulate till groundwater tables totally dry-up or go down beyond reach (too expensive). Indirect costs are those costs that are incurred due to decline in the area under irrigation (paddy) and the changes in cropping pattern. Indirect costs are recurring costs that may grow at an increasing rate as the water table goes down. Since all the irrigated area is devoted to paddy crop, indirect costs are estimated at two levels. Firstly, the loss in net returns per acre due to the decline in net sown area under irrigation. Here net returns are taken from the paddy crop, as paddy is the only crop grown under irrigated conditions. Secondly, losses due to cropping pattern changes are estimated by taking the net return differential between paddy and other crops (weighted average)[12] that replaced paddy and the decline in area under paddy are used to estimate the losses due to shifts in cropping pattern.

[12] Weighted average is calculated based on the proportion of area under the crop. For details see Reddy (2002).

Table 10: Total Costs (direct and indirect) of Groundwater Degradation (Rs./acre)

Village/ Size class	Costs due to groundwater degradation		Total costs (Rupees per acre)
	Direct	Indirect	
Vanaparthy	2744	605	3349
Large Farmers	1782	580	2362
Medium Farmers	4667	1056	5723
Small Farmers	5354	1020	6374
Marginal Farmers	1259	120	1379
Teegaram	3831	1708	5539
Large Farmers	732	1455	2187
Medium Farmers	1889	2236	4125
Small Farmers	5673	1209	6882
Marginal Farmers	11031	3248	14279
Vaddicherla	13159	1910	15069
Large Farmers	6158	2001	8159
Medium Farmers	10694	2733	13427
Small Farmers	17696	2091	19787
Marginal Farmers	36855	7747	44602

The direct (sunk + replacement) costs range from Rs. 2744 per acre in Vanaparthy to Rs. 13159 per acre in Vaddicherla. At the household level these costs are substantial ranging from Rs. 18 to 42 thousand among the sample villages. Though there is no clear pattern in these costs across size classes at the household level, on per acre basis the burden seems to be much higher on small and marginal farmers in all the sample villages. These high costs result in destabilising the household economy, as the withstanding capacity of these farmers is marginal. This is more so in the scarcity villages where burden is more coupled with the instability in crop production. Compared to direct costs the burden of indirect costs is much lower, in terms of per household as well as per acre. Indirect costs range from Rs. 605 per acre in Vanaparthy to Rs. 1910 per acre in Vaddicherla. In the case of indirect costs also the burden is disproportionately born by small and marginal farmers in most of the cases though the reverse is true if we look at per household losses. On per household basis these costs range from Rs. 4990 in Vanaparthy to Rs. 8173 in Teegaram.

On the whole the total costs (direct and indirect) of degradation range from Rs. 3349 per acre in Vanaparthy to Rs. 15069 per acre in Vaddicherla (Table 10). On both the accounts the costs are substantially lower in Vanaparthy. This is mainly due to the presence of percolation tank in this village. For in all the villages more than 80 per cent of the respondents felt lack of proper maintenance of the tank or its low capacity as the reasons for the present status of groundwater. And the next important reason is the increased number of bore wells. The magnitude of losses increases, as the farm size declines. Except in the case of Vanaparthy, the costs of groundwater depletion are disproportionately born by marginal and small farmers.

IV Policy Directions

This paper was set out to understand the relative importance, effectiveness and strengths of property rights and collective action in alleviating poverty on the backdrop of water management in AP. Existing property rights are often found to be biased against the poor due to the absence of equity concerns. Even the new institutional arrangements promoting collective strategies in canal water management have not addressed the equity issues. On the contrary, the new institutions perpetuated the socio-economic inequalities, as 'elite capture' is widespread. In the absence of equity concerns in the existing property rights the new collective strategies are not effective in addressing the issues of poverty. In fact, this could be one of the reasons for the widespread failure of collective action strategies in the case of WUAs. While collective action could have initiate changes in property rights regimes, incorporating the equity issues in to property rights involves transaction costs and go against the existing group interests. Devolution of powers to WUAs, as per the original mandate, would have helped in addressing the equity issues. While WUAs were initiated with strong political support, devolution of powers to WUAs has not taken place even after six years of their existence, as most of the important functions like assessment, collection of water charges, sanctioning of works, etc., are still in the hands of the irrigation department. It may be argued that political will is a necessary but not a sufficient condition for making the WUAs autonomous and self-sufficient. Restructuring and reforming of the State irrigation departments and the bureaucracy is critical for effective and sustainable irrigation institutions.

On the other hand, equity based property rights facilitate collective action strategies. Equity appears to be the critical factor in determining the effectiveness of collective action and property rights in addressing poverty. At the ground level the poverty goal necessitates a focus on the specific needs of the poor and especially landless and land poor families. Distortions in access to groundwater epitomises the need for collective strategies for managing it. The issue of how to secure the rights and entitlements of poor people to access water needs to be resolved. Experience from the *Pani Panchayat* approach developed in Maharashtra and elsewhere could inform this process. Equity in the distribution of economic gains among the community members is as important as the equity in access. Equity issues pertain to the neutrality of technology in terms of location (different geographic locations) and well being (economic status) of the communities. Inequity in the former case is purely technical while the later is institutional. For, no technology has an in-built bias towards a particular class or caste. The bias is always due to the existing institutional (property rights) structures (agrarian structure, credit markets, social structure, etc.). Inequalities could be minimised through more egalitarian institutional arrangements and legislation. In other words, technical inequalities can be corrected though compensating the participants of the disadvantaged locations. And distribution bias reduced through correcting distortions in land, labour, water, credit markets and property rights regimes.

References:

Agrawal, B. (2001), "Participatory Exclusions, Community Forestry, and Gender: An Analysis of South Asia and a Conceptual Framework", *World Development,* 29(10): 1623-1648.

Baland, J.M and Platteau, J.P. (1996). *Halting Degradation of Natural Resources: Is there a Role for Rural Communities*? Oxford, U.K.: Clarendon Press.

Birner R (2004), Actors, Institutional Change and Poverty Reduction;(5th Session), E-conference organised by CAPRi on Poverty, Property rights and Collective Action (CAPRi-talk).

de Janvry Alain (1993), "State, Market and Civil Organisations: New Theories, New Practices and their Implications for Rural Development," *World Development*, Vol. 21, No. 4, April.

Deshpande R.S. and V. Ratna Reddy (1991), "Differential impact of watershed based technology: Some Analytical Issues", *Indian Journal of Agricultural Economics*, 46(3): 261-269.

Di Gregorio, M (2004). Conceptions of poverty and the contributions of property rights and collective action to poverty reduction (Overview of Concepts), 1St Session; E-conference organised by CAPRi on Poverty, Property rights and Collective Action (CAPRi-talk).

Fakir, S (2004). Conceptions of poverty and the contributions of property rights and collective action to poverty reduction (Overview of Concepts), 1St Session; E-conference organised by CAPRi on Poverty, Property rights and Collective Action (CAPRi-talk).

Gans, O. (1989). Economic Analysis of Ecological Dis equilibrium in Industrialized and Developing Countries' in Gins Oscar (ed), *Environmental and Institutional Development: Aspects of Economic and Agricultural Policies in Developing Countries*, Vela breitenbach Publishers, Saarbruken.

GoI (1994). *Guidelines for Watershed Development*, Ministry of Rural Development, New Delhi, October.

GoI (2001) Approach Paper to the Tenth Five Year Plan (2002-07), Planning Commission, New Delhi, September.

GoI (2003) Watershed Guidelines (Hariyali), Ministry of Rural Development, New Delhi.

GoI (2006), *From Haryali to Neeranchal: Report of the Technical committee on Watershed Programmes in India*, Department of Land Resources, Ministry of Rural Development, Government of India, January.

Libecap Gary D (2002), "A Transactions-Costs Approach to the Analysis of Property Rights", in Eric Brousswau and Jean-Michel Glachant (eds.) *The Economics of Contracts: Theory and Applications*, Cambridge University Press, Cambridge, UK.

Mwangi, E.N (2004), Conceptions of poverty and the contributions of property rights and collective action to poverty reduction (Overview of Concepts), 1St Session; E-conference organised by CAPRi on Poverty, Property rights and Collective Action (CAPRi-talk).

Ostrom, E., Gardner, R., & Walker, J. (1994*), Rules, games, and common-pool resources*. Ann Arbor: University of Michigan Press.

Reddy V Ratna (1999), “User Valuation of Renewable Natural Resources: User Perspective”, *Economic and Political Weekly,* Vol. XXXIV, No. 23, 5 June, 1999.
Reddy, V. Ratna (2000), Watershed Development for Sustainable Agricultural: Need for an Institutional Approach, *Economic and Political weekly*, 35(38): 3435-3444.
Reddy. V. Ratna (2002), “Water Security and Management: Lessons from South Africa”, *Economic and Political Weekly.* Vol.37 (28): 2827-81.
Reddy V. Ratna and P. Prudhvikar Reddy (2002), “Water Institutions: Is Formalisation the Answer? (A Study of Water User Associations in Andhra Pradesh)” (jointly), *Indian Journal of Agricultural Economics,* Vol. 57, No.3, July-September.
Reddy V Ratna and Robert Jenkins (2006), “Decentralisation, Participatory Institutions and Elite Capture: A Case of Watershed Development Programme in Andhra Pradesh, India, Unpublished Paper, Centre for Economic and Social Studies, Hyderabad.
Reddy, V Ratna; U. Hemantha Kumar; D. Mohan Rao (2005), “Watershed Management for Sustainable Agriculture: Need for an Institutional Approach”, Mimeo, CESS, Hyderabad.
Singh Katar (1994), *Managing Common Pool Resources: Principles and Case Studies*, Oxford University Press, New Delhi.