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## **Economic Scenario of Farmers in Water Users Co-operatives Across Levels of Water Governance in Cauvery Basin of Karnataka**

**B.K. Rohith and M.G. Chandrakanth\***

### PREAMBLE

Water management problems related to the allocation and use of water in the distribution network are fraught with poor maintenance, degraded infrastructure and lack of collective action. With increasing water scarcity, frequent non-cooperation and non-compliance due to water distribution issues at macro and micro levels, water governance through institutional arrangements governing water resource development, allocation, and management is crucial for policy attention. The World Bank lending towards irrigation infrastructure which formed 7.5 per cent of the total funding earlier, now reduced to two per cent and is largely devoted to institutional innovations in water. As the transaction costs of governing water sector are increasing, it is in order to explore, compare and contrast the economic performance of Water Users Co-operatives (WUCS) across different levels of governance. The role of water institutions is thus critical, as the country is reaching the limit of its utilisable water resource potential. Good governance entails clearly defined objectives, interaction among members, adaptive capacity, and compliance ability for institutional performance. These reduce transaction cost due to collective action.

### *Water Use Inefficiency in Cauvery Basin*

In Cauvery basin, inefficiency in the use of canal water has led to environmental problems like salinity, alkalinity and water logging. Due to the predicament, the net loss in paddy crop on saline-sodic soils is Rs. 1,530 per acre, that in water logged soils is Rs. 40 per acre, while the net returns in normal soils is Rs. 5,005 per acre (Nagaraj *et al.*, 2003). Thus, in order to improve water use efficiency, capacity building of the farmers is crucial. As paddy and sugarcane are the major crops in Cauvery Basin, the capacity building of farmers with regard to water requirements across stages and location of crops and lands can bring out qualitative reforms

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towards efficient and equitable use of scarce water maximising net returns in addition to appreciating the tail enders to get adequate share of water. These require group activity through collective action in WUCS.

#### *Sir M. Vishveshwaraiah's Contribution*

In the 1900s, the First Irrigation Commission (1901-03) strongly recommended the management of water distribution by cultivators, but with the State consolidated control through legal instruments. The Royal Commission on Agriculture (1928) reiterated the recommendation of participatory management. The Deccan Canal Inquiry Committee (1932) reviewed the cost of operation and management of the distribution system by the groups of irrigators. Sir M. Visveswaraya, the architect of India's irrigation sector emphasised handing over of irrigation distribution to village panchayat in the Irrigation Inquiry Committee Report. However, all these recommendations did not materialise as it was difficult politically to keep out the bureaucracy from the O and M function (Narayanamoorthy and Deshpande, 2005).

#### *Objective of the Study*

The idea of WUA was first proposed by Sir M Vishveshwaraiah and the World Bank in the recent years took cue from Sir M Vishveshwaraiah and recommended formation of Water Users Association for bringing water use efficiency and equity. This study examines the economic performance of WUCS in Cauvery Basin of Karnataka State across different levels of water governance. The study also identifies the factors that distinguish members from non-members of WUCS.

#### *Governance of WUCS*

In reconnaissance survey of thirty WUCS (Appendix 1) in the Krishnaraja Sagara (KRS) command area in the Tirumakudalu Narasipura, Mysore district, WUCS with 'good' and 'poor' levels of governance were apparent. The members of WUCS with 'good' governance, made efforts to use the infrastructure grant from the Command Area Development Authority (CADA), maintained records of WUCS, and involved in collective action of cleaning canals, volunteering labour for building WUCS infrastructure and regularly participated in General Body meeting. The WUCS with 'poor' governance had diagonally opposite features. Thus, the list of WUCS with Good Governance (WUCSGG) and WUCS with Poor Governance (WUCSPG) was prepared. Among those with good governance, there were WUCS which also had conjunctive use of canal and groundwater, for which a separate list was prepared. From among the list of 30 WUCS, during the pre-testing it was further found that Rajapameshwari WUCS (Kempaiyanhundi) and Benakanahalli WUCS were exhibiting good governance, while Yariyur WUCS was with poor governance and were chosen for detailed study (Table 1).<sup>1</sup>

TABLE 1. DETAILS OF SAMPLE WATER USER COOPERATIVE SOCIETIES (WUCS) CONSIDERED FOR THE STUDY IN CAUVERY BASIN OF KARNATAKA

Sl. No. (1)	Governing Features of the society (2)	WUCS with Good Governance (WUCSGG) (3)	Conjunctive use WUCS with Good Governance (CUWUCSGG) (4)	WUCS with Poor Governance (WUCSPG) (5)
1.	Name of the society and location	Rajaparameshwari WUCS, Kempaiyanhundi, T. Narasipur Taluk	Benakanahalli WUCS, T. Narasipur Taluk	Hiriyur WUCS, T. Narasipur Taluk
2.	Command (acres)	1353	1525	960
3.	Year of MOU	2001	2001	Not yet
4.	One time grant received	Yes	Yes	No
5.	Canals supplying irrigation water	Rajaparameshwari canal, Mahadevpura Anicut, Cauvery river	Chikavedaraya Canal Cauvery river (CDS)	Minor - 15, 17 Sujalooru Distributory, Kabini
6.	Villages in the command area of the society	Hindavalu, Rayarahundi, Hoskempaiyanhundi, Kempaiyanhundi, Bommanayakanahalli	Hosvatti, Chikkabovalli, Virapandavarahalli, Benakanahalli, Meganahalli, Musukanakopalu	Hiriyur, Hospura
7.	Infrastructure grant	Drawn (Three lakh rupees)	Drawn (One lakh twenty thousand rupees)	Not Drawn
8.	Visit by farmers of other WUCS	Frequent visits	Average visits	None
9.	Maintenance of Records of WUCS	Well maintained	Modest maintenance	No records kept
10.	Collective action of members for WUCS work	Members: 1. Volunteered in cleaning/weeding canals 2. Offered 'shramadan' voluntary labour for infrastructure building 3. Regularly attended General body meeting	Members 1. Offered 'shramadan' voluntary labour for infrastructure building 2. Regularly attended General body meeting	Members participated in none of the activities related to collective action. They did not participate in General body also.

Source: Rohith, 2007.

### *Conjunctive Use and Tail End Areas*

Conjunctive use (CU) in this study refers to use of both surface and groundwater at a time or during different times by the farmers. CU by default, keeps the farmer active since he or she has to manage two sources of irrigation. CU not only promotes use of two sources of water, but also educates the farmers regarding the economic value of water. Since the farmers bear the cost of groundwater compared with surface water, they will be relatively more efficient in the use of groundwater. Thus, CU reflects (1) efficiency in water use and (2) equity in water use, since it facilitates access to water for tail end farmers. Usually conjunctive use areas will be in the tail end regions since surface water will not be available for the entire cultivating season. Among the two WUCSGG mentioned above, in Benakanahalli WUCS there was conjunctive use of water, while in Rajaparameshwari WUCS, there was no conjunctive use of water. The Benakanahalli WUCS had several borewells to provide summer irrigation and hence was named as "CWUCSGG" (Conjunctive WUCS with Good Governance).

### *Pricing Issues*

Surface or canal water was supplied by Irrigation Department to WUCS on volumetric basis at the rate of Rs. 12 per 1000 cubic meter. The WUCS were empowered to collect water charges from its members on the basis of area and crop grown (present water charges are in Appendix 3). The government recommended water charges for different crops and the WUCS were empowered to charge the price depending on the economic viability of the WUCS. It is expected that the WUCS purchases water on volumetric basis from Cauvery Neeravari Nigam (CNN) and sells irrigation water on per acre basis charging on per acre basis. The WUCS is expected to appropriate the profits realised in water rate between the two methods. Regarding groundwater, the farmers incurred the investment on irrigation wells, as well as the associated O & M costs. Canal irrigation farmers were to pay for the water rates which were modest.

### *Details of Water Users Cooperative Societies in Cauvery Command*

Initially the Command Area Development Authority (CADA), Mysore identified 592 (Appendix 2) Water User Groups, which expressed interest to form WUC societies during 2004. However, only 39 per cent of the societies signed MOU out of the registered WUCS. During 2001, there were 66 societies registered and 30 per cent of them were from the Krishnarajasagara (KRS) command. The cropped area of KRS was maximum with 90,224 hectares, followed by Kabini command (46,139 hectares).

Government of Karnataka amended the “Karnataka Irrigation Act of 1965” and the “Karnataka Irrigation (levy of betterment contribution and water rate) Act of 1957,” by passing “The Karnataka Irrigation and Certain Other Law (Amendment) Act of 2000.” The major changes brought about in the establishment of Water Users Cooperative Societies at four levels of Irrigation System Management are (i) Water User Cooperative Society (WUCS) at primary level; (ii) The Distributory Level Federation at distributory level; (iii) The Project Level Federation at project level and (iv) Apex body at state level.

Water User Cooperative Societies are registered under the “Karnataka Cooperative Societies Act of 1959” (Karnataka Act 11 of 1959). Each society will have a specific area of operation in the command area as specified by the Command Area Development Authority (CADA). The members of each society consist of not less than sixty per cent of the water users for cultivation of land and their total land holding form at least fifty one per cent of the total land holding. In Karnataka, about 2,798 societies have been recognised to form Water User Cooperative Societies, of which about 1,888 WUCS have been registered.

### *Area of Operation and Members of WUCS*

The WUCS at primary level is formed for every 500-1000 hectares in the command area. The size of the area is delineated by Irrigation Department and CADA for the particular WUCS. The farmers in the area of operation of WUCS are eligible to become members of WUCS through payment of Rs. 106 towards the share amount of Rs. 100, entry fee of Rs. 5 and share fee of Rs. 1. In order to attain social equity in the WUC society, the membership cost of SC/ST is borne by the Government.

There are nine directors in each WUCS, where five directors are farmers' representatives, of whom one farmer is from tail end in the last 20 per cent of the land in the jurisdiction of WUCS. In order to promote participation of vulnerable groups in decision-making, one position of director is reserved for woman, one to Scheduled Caste/Scheduled Tribe and one to Other Backward Caste or Minority in the region. These directors are elected from among the member farmers, where as one director is the "Junior Engineer" from Irrigation Department as a government nominee. The two permanently invited members are, "Assistant Agricultural Officer" of CADA/Agricultural Department and "Senior Inspector of Cooperative Society" of CADA.

After the registration of the WUCS a "One Time Functional Grant" was provided to keep WUCS operational, which comprises contributions from farmers (Rs.50), State Government (Rs. 225) and the Central Government (Rs. 225) per hectare of land. At first, the farmers' contribution should be collected and deposited in the co-operative bank and then CADA to be informed, to receive the government contribution. The WUCS can utilise only the interest generated from the "One Time Functional Grant" for administration purpose. The WUCS is allotted office/godown grants to construct godown in the village. The godown could be used as warehouse and for distributing fertilisers and pesticides (Command Area Development Authority, 2000 a,b).

### METHODOLOGY

Field study of three WUCS, namely, Rajaparameshwari WUCS (WUCS with Good Governance - WUCSGG), Benakanahalli WUCS (Conjunctive use WUCS with Good Governance - CUWUCSGG) and Yariyur (WUCS with Poor Governance – WUCSPG) is conducted to know the water distribution status of each WUCS with respect to the different reach (head and tail reach) of farms in WUCS command. In both the head and tail reach of three WUCS, fifteen farmers were interviewed personally (total of 90 sample farmers) using the Schedule. The societal and economic information were collected for analysis from 90 sample farmers.

### *Factors that Discriminate Members of WUC from Non-Members*

It has been hypothesised that high land holding size of farmers and annual net returns positively facilitate farmers to enrol as WUC member. The conjunctive use factor given by the ratio of the area under groundwater irrigation to total area irrigated facilitates the farmer to enrol as WUC member. The large distance of the farm from the canal deters the farmer from becoming member of WUC. The Linear Discriminant function analysis was used to analyse the factors that discriminate members from non-members of WUCS with variables as under:

Z = Dependent variable (Member =1, Non-member=0),

b's = Standardised Discriminate coefficients or scores,

X<sub>1</sub> = Land holding of the farmers (acres),

X<sub>2</sub> = Magnitude of conjunctive use given by ratio of borewell irrigated area to total irrigated area,

X<sub>3</sub> = Distance of the farm from the canal outlet (meters),

X<sub>4</sub> = Paddy area grown during summer season (acres), and

X<sub>5</sub> = Annual net returns of the farmer per acre (Rs.).

## RESULTS

### *Socio-Economic Characteristics*

In the command of WUCSGG, CWUCSGG and WUCSPG, there was a concentration of marginal farmers (Table 2). About twenty six per cent of farmers had received college education in Active-WUC as compared to 20 per cent and 17 per cent farmers in the CWUCSGG and WUCSPG respectively. About 53 per cent of the farmers are members in WUCS with Good Governance (WUCSGG) as compared to 50 per cent and 34 per cent, in CWUCSGG and WUCSPG command respectively.

About fifty per cent of the farmers in the study area rear cows and thirty per cent of the farmers possess bullock pair. Among the farmers in the study, 13 per cent had tractors, mainly used in ploughing. The CWUCSGG farmers possessed more irrigation pump-sets as compared to WUCSGG and WUCSPG. The socio-economic features of sample farmers indicate that average size of holding is 5.1, 2.17 and 2.72 acres in WUCSGG, CWUCSGG and the WUCSPG. In WUCSPG, the percentage of the marginal farmers was 57 per cent, which is 21 per cent and 14 per cent higher than that in WUCSGG and CWUCSGG.

TABLE 2. SOCIO-ECONOMIC FEATURES OF SAMPLE FARMERS IN SAMPLE WATER USER CO-OPERATIVE SOCIETIES CONSIDERED FOR THE STUDY

Sl. No. (1)	Features of the society (2)	WUCS with Good Governance (WUCSGG) (3)	Conjunctive use of WUCS with Good Governance (CUWUCSGG) (4)	WUCS with Poor Governance (WUCSPG) (5)
I	Land Holding	Number of farmers	Number of farmers	Number of farmers
1.	Marginal farmers (< 2.5 acres)	14 (47)	15 (50)	17 (57)
2.	Small farmers (2.5 and 5 acres)	10 (33)	10 (33)	11 (37)
3.	Large farmers (> 5 acres)	6 (20)	5 (17)	2 (6)
	Total	30	30	30
II	Education level			
1.	Illiterate	2 (7)	1 (3)	2 (6)
2.	Primary school (1-7)	6 (20)	7 (23)	5 (17)
3.	Secondary school (8-10)	14 (47)	16 (54)	18 (60)
4.	College level	8 (26)	6 (20)	5 (17)
III	Membership in WUC (No.)	16	15	8
IV	Livestock			
1.	Farmers with bullock pair	10 (33)	10 (33)	7 (23)
2.	Farmers with milch cows	15 (50)	17 (57)	16 (56)
3.	Farmers with she-buffalos	5 (17)	6 (20)	5 (17)
V	Farm power and machinery			
1.	Farmers owning bullock cart	7 (23)	8 (27)	5 (17)
2.	Farmers owning tractors	5 (17)	4 (13)	3 (10)
3.	Farmers owning borewell	5 (17)	11 (36)	2 (7)

Source: Rohit (2007).

Note: Figures in parentheses indicate percentage to total.

Secondary school education was pursued by 50 per cent of family members across the three groups of WUCS. In Benekahalli WUCS, about 36 per cent of sample farmers possessed irrigation wells, and this indicated that there is conjunctive use of water, where both canal and well water are used for irrigation. The number of farmers possessing bullock pairs was higher than the number of farmers possessing tractors, which indicated that due to small holding, the farmers used draught power for cultivation and transportation. Bullock cart, which is a major means of transportation for manures, fertilisers, seeds and fodder, was possessed by 25 per cent of the farmers in the study area.

### Cropping Pattern

The area under WUCS is classified as head and tail reach to examine whether there is equity in water distribution between farms located at head and tail reach of the command. In the head reach of WUCSGG, paddy was sown both in *kharif* and summer seasons. But in the tail end of WUCSGG, paddy area during summer season formed 26 per cent of the gross cropped area (GCA) while it formed 39 per cent during *kharif* season (Appendix 4). The other low water consuming and drought tolerant crops like horsegram (2.1 per cent), ragi (5 per cent) and groundnut (3.36 per cent) were also grown. The cropping intensity had fallen to 187 per cent in the tail



reach of WUCSGG, as 13 per cent of the area was kept fallow during summer due to unsecured irrigation.

In the tail reach of Conjunctive use WUCS with Good Governance (CUWUCSGG) 17.2 per cent of the gross cropped area (GCA), was under annual crops comprising sugarcane and tuberose. The paddy area, which was 40 per cent during *kharif*, reduced to 1 per cent in summer. Even though this WUCS had higher number of borewells than others, borewells were used to irrigate sugarcane during summer with protective irrigation. Due to conjunctive use by tail reach farmers, the tail reach had almost the same cropping intensity (172 per cent) as in the head reach (175 per cent).

In WUCSPG, annual crops like sugarcane were not grown, but paddy was grown on cent per cent of the land in *kharif* season. The cropping intensity in head reach was 191 per cent as compared to 165 per cent in the tail reach. Fallow land during summer was 35 per cent in tail reach, and the crops grown were blackgram, ragi and cowpea, which were less economical, and also low water consuming crops.

#### *Water Availability*

The water was released to the head reach farmers from August to November for their *kharif* paddy crop and during January to April for summer paddy. This volume of water would reach the tail reach at least after a month from the head reach as also in lower volumes. Hence in tail reaches conjunctive use is followed. In WUCSPG tail reach area, however conjunctive use is not followed.

As water was not provided on volumetric basis from Irrigation Department to WUCS and from WUCS to farmer members the volumetric measure of water availability was not available. However a realistic measure of water availability is translated in the diversity in crop pattern which indirectly reflects the water availability. Accordingly in head reach areas of active and passive WUCS there was uniformity in crop pattern dominated by paddy. Since paddy requires the largest volume of water per unit area and time, the head reach farmers obviously have higher water availability than tail reach farmers. The conjunctive use has been only for sugarcane and tuberose crops. In tail reach farms of conjunctive use the crop pattern is relatively diverse and low water availability is one of the causes.

#### *Crop Productivity*

Paddy being the major crop across all the WUCS, the productivity is below that prescribed in the package of practices of the University of Agricultural Sciences, Bangalore. The crop productivity varied in a narrow range across WUCS. As the procurement price was around Rs. 560 per quintal, the farmers gained at cost A1, while they lose at cost B2 (Table 3).

TABLE 3. PRODUCTIVITY OF PADDY (VAR: JAYA) ACROSS WUCS IN CAUVERY BASIN

Features →	WUCS with Good Governance (WUCSGG)		Conjunctive use WUCS with Good Governance (CWUCSGG)		WUCS with Poor Governance (WUCSPG)	
	Head reach (2)	Tail reach (3)	Head reach (4)	Tail reach (5)	Head reach (6)	Tail reach (7)
Reach ↓ (1)						
Paddy output (in quintals) per acre as prescribed in package of practices of UAS Bangalore	22-24	22-24	22-24	22-24	22-24	22-24
Paddy output (in quintals) per acre realised by farmers	21.84	19.24	19.84	20.8	22.39	18.23
Paddy straw (By-product) cartloads per acre	3.5	3.2	2.9	3	2.8	3
Gross returns from paddy in Rs. per acre	13,882	12,516	12,612	13,063	14,083	11,447
Cost A1: working capital, depreciation, irrigation cost, canal maintenance charge, land revenue	8,720	8,805	6,650	8,084	8,139	8,180
Cost B2: A1 + int on fixed cost + rental value of land	11,779	12,118	10,079	11,126	11,477	11,520
Cost of cultivation per quintal considering A1	399	457	335	388	363	448
Cost of cultivation per quintal considering B2	539	630	508	535	513	632
Minimum support price Rs. per quintal of paddy (2004-05)	560	560	560	560	560	560
Net returns per acre over cost A1 from paddy	5,162	3,711	5,962	4,979	5,944	3,267
Net returns per acre over cost B2 from paddy	2,102	398	2,533	1,937	2,606	-73

Source: Rohith (2007).

### Net Returns of Farms in WUCS Command

The net returns of *kharif* crops of head reach farms of WUCSGG (Rs. 2,102), CWUCSGG (Rs. 2,453) and WUCSPG (Rs. 2,606) do not differ greatly (Table 4), but they do differ with tail reach farms. The difference in net returns per acre is higher when compared with WUCSPG, followed by WUCSGG and CWUCSGG. Similarly when the net returns of summer crops are considered, the head reach farms of CWUCSGG and WUCSGG had 112 per cent and 63 per cent higher net return than the WUCSPG command. The net returns per annum was maximum in the head reach of the CWUCSGG (Rs. 6,890) which is 62 per cent higher than head reach of WUCSGG (Rs. 4,237) and 81 per cent higher than the WUCSPG (Rs. 3,795). The

farmers in the head reach of CWUCSGG are economically better placed as they grow sugarcane and tuberoses which fetched higher returns, due to conjunctive use of surface water and groundwater during summer season.

Between head and tail reach farms, it is found that the difference in net returns per annum is maximum in CWUCSGG (Rs. 3,584), followed by WUCSPG (Rs. 3,370) and WUCSGG (Rs. 2,603). This indicates difference in the water sharing among the command society farmers. The tail reach farmers of CWUCSGG (Rs. 3,306) receive similar net return which the head reach farmer of WUCSPG received (Rs. 3,795), which implies that there is no discernible difference between a farm in the tail reach of CWUCSGG, and that in the head reach of WUCSPG. The conjunctive water use helped the active WUCS to supplement the available surface water.

#### *Net Returns of Member and Non-Member Farmers*

In WUCSGG the net returns of member farmers per acre were 24 per cent lesser than non-member farmers (Table 5). This is unusual, since the non-member farmers had their farms located at better positions than the member farmers. These better positions are nearer to the pipe outlets and in the head reach of the WUCS area. In WUCSPG society, the net returns per annum of the member farmers were 98 per cent higher than the non-members. Here only the progressive farmers have become members.

Even though the Command Area Development Authority (CADA) started promoting formation of water user co-operative society at the same time in all regions, some societies like WUCSGG were formed early, as the farmers of these societies who did not receive reliable water supply, organised themselves and promoted the society activities.

In the WUCSPG, there was no such motivation among farmers to form the organisation. The prevalence of small size holding can be one of the demotivating factors. Due to lack of co-operation, this society was formed recently and has only 34 per cent membership. In tail reach of WUCSPG, the size of holding per farm is below one acre and these farmers received the land from the government as erstwhile landless labourers. They lacked motivation to ensure as member of WUCS.

#### *Net Returns of Small and Large Farmers*

The small and marginal farmers of WUCSGG and CWUCSGG have realised higher net returns per acre (Table 6) than large farmers. The WUCSGG and CWUCSGG of small and marginal farmers received 18 per cent and 19 per cent higher returns than the large farmers. The small and marginal farmers received higher net returns from sugarcane, which increased the net returns per acre per annum. Even

TABLE 4. COMPARATIVE ECONOMICS CONSIDERING ALL CROPS CULTIVATED IN HEAD AND TAIL REACH OF WUCS IN CAUVERY COMMAND AREA, 2005

Annual/Seasonal crops (1)	<i>(area in acres, net returns per acre in Rs.)</i>											
	WUCS with Good Governance (WUCSGG)				Conjunctive use WUCS with Good Governance (CUWUCSGG)				WUCS with Poor Governance (WUCSPG)			
	Head Reach Farmers (N=15)	Tail Reach Farmers (N=15)	Head Reach Farmers (N=15)	Tail Reach Farmers (N=15)	Head Reach Farmers (N=15)	Tail Reach Farmers (N=15)	Head Reach Farmers (N=15)	Tail Reach Farmers (N=15)	Head Reach Farmers (N=15)	Tail Reach Farmers (N=15)	Head Reach Farmers (N=15)	Tail Reach Farmers (N=15)
Area (2)	Net Return (3)	Area (4)	Net Return (5)	Area (6)	Net Return (7)	Area (8)	Net Return (9)	Area (10)	Net Return (11)	Area (12)	Net Return (13)	
Sugarcane, tuberose	30.4	2,102	26.25	522	32.3	2,453	40.8	2,259	33.35	2,606	23.8	-72
Khariif (paddy, ragi, tomato, groundnut)	30.4	2,135	22.25	1,732	19.3	2,770	30	883	30.35	1,306	15.5	761
Summer (paddy, ragi, groundnut, cowpea, tomato, sunflower, horsegram, blackgram, green manure crops)												
Net Returns per acre per annum considering all crops above	4,237		1,634		6,890		3,306		3,795		425	

Source: Rohith (2007).

TABLE 5. COMPARATIVE ECONOMICS OF CROPS GROWN BY MEMBER AND NON-MEMBER FARMERS OF THE WUCS IN CAUVERY COMMAND AREA, 2005

Annual/Seasonal crops (1)	<i>(area in acres, net return per acre in Rs.)</i>											
	WUCS with Good Governance (WUCSGG)				Conjunctive use WUCS with Good Governance (CUWUCSGG)				WUCS with Poor Governance (WUCSPG)			
	Member (N=16)	Non-member (N=14)	Member (N=15)	Non-member (N=15)	Member (N=8)	Non-member (N=22)	Member (N=8)	Non-member (N=22)	Member (N=8)	Non-member (N=22)	Member (N=8)	Non-member (N=22)
Area (2)	Net Return (3)	Area (4)	Net Return (5)	Area (6)	Net Return (7)	Area (8)	Net Return (9)	Area (10)	Net Return (11)	Area (12)	Net Return (13)	
Annuals	4.5	5,291	1.0	9,507	11.5	13,464	4.0	11,411	-	-	-	-
Khariif	39.0	1,144	17.7	2,601	52.5	2,453	20.0	2,453	30	2,168	27.1	1,171
Summer	37.0	2,915	15.7	3,063	35.5	1,492	13.8	2,207	26	1,123	19.8	572.8
Net returns per acre per year	-	4,052	-	5,541	-	5,259	-	5,211	-	3,141	-	1,588

Source: Rohith (2007).

TABLE 6: COMPARATIVE ECONOMICS OF CROPS GROWN BY SMALL AND LARGE FARMERS OF THE WUCS IN CAUVERY COMMAND, 2005

*(area in acres and net return per acre Rs.)*

Annual/Seasonal crops (1)	WUCS with Good Governance (WUCSGG)			Conjunctive use WUCS with Good Governance (CUWUCSGG)			WUCS with Poor Governance (WUCSPG)		
	Small and marginal farmers (N=24)	Large farmers (N=6)	Net return (3)	Small and marginal farmers (N=25)	Large farmers (N=5)	Net return (7)	Small and marginal farmers (N=28)	Large farmers (N=2)	Net return (13)
	Area (2)	Area (4)	Area (5)	Area (6)	Area (8)	Area (9)	Area (10)	Area (12)	Area (11)
Annual crops	1.3	4	5,687	11.5	4	15,147			
<i>kharij</i> crops	35.2	21.5	1,792	37	35.5	3,154	45.1	12	2,109
Summer crops	31.2	21.5	2,037	26.25	23	966	35.85	9.9	802
Net returns per acre per year		4,885	4,120	5,913	4,931	2,537			2,771

*Note:* The small and marginal farmers are those who have less than five acres and large farmers are those who have more than 5 acres.

though the large farmers of CWUCSGG received higher net returns in summer, their net returns per annum decreased as the returns from summer crops were 60 per cent (Rs. 966) lower than that of the small and marginal farmers.

There is uniformity in the net returns per annum of small and large farmers of WUCSPG, as the net returns of large farmers was only 9 per cent higher than that of the small and marginal farmers. The proportion of summer paddy area for large farmers was 57 per cent higher than that of the small and marginal farmers of 0.06 per cent, and this shows that large farmers' land are at better locations to access irrigation water for summer crop. The WUCSPG have large number of marginal farmers who have their land in the tail reach where they can cultivate only one crop per year. The marginal farmers did not want to enrol members of WUCS, as they did not express confidence with the WUCS. They opined that paying Rs. 125 for membership was also difficult and felt that their opinion may not be heard in WUCS.

#### *Economic Impact of WUCS*

The results obtained from the above were tested for their statistical significance using ANOVA followed by the t test and the differences were found to be statistically significant (Table 7). The economic impact of WUCS on agriculture productivity is hypothesised to reflect in the economic performance of farmers belonging to the three types of WUCS (WUCSGG, CUWUCSGG and WUCSPG). The economic performance of farmers is gauged by the average net returns per acre per year from all crops. The result of the ANOVA performed to test this across the three types of WUCS indicated that the mean net returns differ significantly among the three types of societies. It is found that the net returns per acre significantly differ between WUCSGG (Rs. 3,989 per acre) and WUCSPG (Rs. 1,980 per acre), as well as between CWUCSGG (Rs. 5,368 per acre) and WUCSPG (Rs. 1,980 per acre). This indicates that the economic impact of WUCS on agricultural productivity is substantial.

TABLE 7. RESULTS OF ANOVA (ANALYSIS OF VARIANCE) TO TEST THE MEAN OF NET RETURNS PER ACRE PER YEAR AMONG WUCS PRESENT IN CAUVERY COMMAND, 2005

(1)	Sum of square (2)	df (degrees of freedom) (3)	Mean squares (4)	F-value (5)	Significance (6)
Between group (WUCSGG, CWUCSGG and WUCSPG)	1.73 E+08	2	86680946	5.402	0.006
Within group	1.40 E+09	87	16046791		
Total	1.57 E+09	89			

Source: Rohith (2007).

### *Factors Facilitating Farmers to be Members of WUCS*

The discriminant function analysis indicated that the size of holding and the conjunctive use variable were the major factors influencing the discriminating power of the farmers who become members of WUCS. The efficiency of the linear discriminant model in classification indicated that out of the total fifty-one non-members, 86 per cent were classified as non-members using the discriminate function (Table 8).

TABLE 8. CLASSIFICATION RESULT OF THE DISCRIMINANT FUNCTION BASED ON ITS DISCRIMINANT SCORES

WUCS membership (1)		Predicted Membership group		Total (5)
		Non-Member (3)	Member (4)	
Original membership (Count)	Non member	44	7	51
	Member	10	29	39
Original membership (Percentage)	Non member	86.3	13.7	100
	Member	25.6	74.4	100

Source: Rohith (2007).

Note: 80 per cent of the original cases are correctly classified by the Linear Discriminant Function.

The original data indicated that in the total sample of 90 farmers, there were 51 non-members (57 per cent) and 39 members (43 per cent) of WUCS. The discriminant function classified that out of 51 non-members, that 44 are non-members. Thus, 86 per cent of the original non-members (=44 out of 51) are classified as non-members. Then out of 39 members, the discriminant function classified, 29 as members. Thus (29 out of 39 =) 74 per cent of the original members are classified as members. The overall prediction ability of the discriminant function is impressive as  $[(86+74)/2=]$  80 per cent of the farmers were classified accurately into their respective categories.

The model is thus able to efficiently classify the farmers as member/non-member of WUCS largely based on the magnitude and significance of the standardised coefficients of predictor variables *inter alia* size of holding (0.802), magnitude of conjunctive use (given by ratio of borewell irrigated area to total irrigated area) (0.552), and paddy area cultivated during summer (0.248) as these are significant at 1 per cent (Table 9). Thus the significant (desirable) characteristics of the predictor variables identified by discriminant function for a farmer to be a member of WUCS are (i) the size of holding with a magnitude of 3.03 acres, (ii) paddy area during summer season with a magnitude of 1.13 acres per farm and (iii) conjunctive use of borewell irrigated area to total area with a magnitude of 0.29 acre of borewell area out of 1 acre of canal irrigated area per farmer.

TABLE 9. DISCRIMINATING FACTORS BETWEEN MEMBER AND NON-MEMBER OF THE WUCS  
DEPENDENT VARIABLE (MEMBER=1, NON-MEMBER=0), NUMBER OF SAMPLE=90

Independent variable (1)	Standardised Coefficients (2)	Non-members mean value (3)	Members mean value (4)	F-value (5)
Size of holding (acres)	0.802**	1.30	3.03	35.1
Conjunctive use variable (ratio of borewell irrigated area to the total irrigated area)	0.552**	0.09	0.29	7.32
Distance of the farm from the canal outlet (meters)	-0.360*	627.45	424.35	3.10
Paddy area during summer season (acres)	0.248**	0.360	1.132	8.21
Annual net returns per year (Rs.)	-0.128	3341.5	4304	1.16
Chi-square value	41.87**			
Eigen value	0.632		Canonical Correlation	0.622

Note: \*\* and \* Significant at 1 and 5 per cent level.

### Comparison of Performance of WUCS

A comparison of the features of performance across the three groups of WUCS reflects that farmers in WUCSGG have relied on collective action to seek grants from CADA for office/godown construction relatively compared to other two groups.

In addition, they played a proactive role in generating external funds for improving their WUCS with the result that their fund per farmer member is twice that of the CUWUCSGG. They also assisted the CADA in cleaning up the canals for smooth flow of irrigation water. The WUCS with Good Governance (WUCSGG) were also efficient in dispute resolution and in getting their accounts audited regularly. The WUCS with Poor Governance (WUCSPG) are yet to have MOU with CADA and hence have not yet obtained office grant and with low performance the funds per farmer is the lowest (Rs.34) (Table 10).

TABLE 10. COMPARISON OF PERFORMANCE OF WUCS

Features (1)	WUCS with Good Governance (WUCSGG) (2)	Conjunctive use WUCS with Good Governance (CUWUCSGG) (3)	WUCS with Poor Governance (WUCSPG) (4)
Command area (acres)	1353	1525	960
Year of MOU between CADA and WUCS	2001	2001	Not yet
One time grant received	Yes	Yes	No
Office or godown grant received	Rs. 3 lakhs	Rs. 1.2 lakhs	None
Proportion of members (per cent)	59	59	34
Funds in WUCS per farmer	1,270	507	34
Percentage of farmers attending GB meeting	87	90	65
Dispute resolution	Yes	Yes	No
Mobilised external financial funds for strengthening WUCS	Yes	No	No
Coop audit of accounts	Audited yearly	Audited yearly	Not audited
Members' collective action in assisting CADA in cleaning canals	Yes	Yes	No

Source: Rohith (2007).



## CONCLUSION

Between the head and tail reach farms, the difference in net returns per annum is maximum in CWUCSGG (Rs. 3,584), followed by WUCSPG (Rs. 3,370) and WUCSGG (Rs. 2,603), which indicates difference in water sharing among farmers societies. The CWUCSGG received the highest net returns per acre per annum of Rs. 5,368 followed by WUCSGG (Rs. 3,989) and WUCSPG (Rs. 1,980), as CWUCSGG grew sugarcane and tuberose which fetched high returns. Thus, among the three groups, there was significant difference in the net returns per acre per year.

Among the factors motivating a farmer to be a member of WUCS, the size of holding was the most important followed by the ratio of ground water irrigation to total irrigation (0.29 acre). Thus the conjunctive use of ground water and surface water forms a crucial variable to motivate the farmer as member of WUCS along with size of holding. This shows that the conjunctive use of water by farmers are relatively efficient since they pay for at least 29 per cent of their total water.

*How to Strengthen the Existing WUCS*

The very idea of formation of WUCS was to improve water use efficiency at the micro and macro level through volumetric measurement and use of water for fair distribution of water among head and tail reaches. This needs infrastructure development and efficiency at three levels – CADA, WUC and farmer member. CADA needs to first develop infrastructure towards volumetric measurement of flow of water through proper outlets as also provide proper lining to the canals, to reduce the transmission and evaporation losses. At present the pipe outlets have rusted and blocked gates. Thus, the water use efficiency needs to be increased first at the CADA level by providing proper canal water flow with proper lining and cleaning of canals with proper water flow and regulating infrastructure. Next, similar correction needs to be made at the WUC level for which farmer members of WUC can collectively act at least in the case of WUCSGG and CUWUCSGG. For each WUC, the water inlets have to be a manageable number for efficiency. Instead, if the water is provided through many inlets, it becomes difficult for WUCS to regulate water inflow. The WUCS have to be trained in collecting water rates from the farmer members. In the third level, the farmer members of WUCS in both head and tail reaches need to adopt field irrigation infrastructure towards efficient use of water. These need capacity building at WUC level and farmer members level towards infrastructure, water use efficiency, payment of canal water charges, canal cleaning and maintenance. In addition, the farmers need to be educated regarding appropriate crop pattern and maintenance of soil fertility status, preventing degradation of soils towards water logging and salinity. The support of the local non-government organisations in social mobilisation can be availed as it is a challenging task to mobilise farmers to adopt to new system of water management through WUCS.

*How to Promote New WUCS*

Taking a cue from the discriminant function analysis used in the study, farmers with conjunctive use of around 0.3 acre, farmers with around 3 acres of holding, and farmers with around 1 acre of area devoted to summer paddy, are more likely to become members of WUCS. In addition, to these factors, the new WUCS need to be promoted towards efficient water use. Appropriate capacity building be initiated to motivate the marginal farmers as members of WUC. Moreover, members need to be educated to treat water as an 'economic good'.

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## NOTE

1. These observations were further validated with The Registrar of CADA, Mysore.

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## APPENDIX 1. LIST OF WATER USER COOPERATIVE SOCIETIES SELECTED FOR THE STUDY

Sl.No. (1)	Name of the WUCS (2)	Project (3)	Date of MOU Signed (4)	Total command area (acres) (5)
1.	Bannur (CDS)	K.R.S	2001	1465
2.	Bannur (KN)	K.R.S	2001	1175
3.	Bannur (RN)	K.R.S	2001	1406
4.	Benakanahalli	K.R.S	2001	1525
5.	Doddamulagodu	K.R.S	2001	1320
6.	Doddebagilu	K.R.S	2001	1322
7.	Hanumanalu	K.R.S	2001	618
8.	Heggur	K.R.S	2001	1094
9.	Kempainahundi	K.R.S	2001	1353
10.	Kethupura	K.R.S	2001	1029
11.	Kodagahalli	K.R.S	2001	1567
12.	Kupya	K.R.S	2001	1353

(Contd.)

## APPENDIX 1. CONCLD.

Sl.No. (1)	Name of the WUCS (2)	Project (3)	Date of MOU Signed (4)	Total command area (acres) (5)
13.	M. Kebbehundi	K.R.S	2005	1519
14.	Maliyur	K.R.S	2001	1200
15.	Megalakoppalu	K.R.S	2001	1048
16.	Turuganur	K.R.S	2001	1255
17.	Aadibettahalli	Kabini	2001	850
18.	Akkur	Kabini	2001	835
19.	Chowhalli	Kabini	2001	983
20.	Hemmige	Kabini	2004	1770
21.	Kannahalli	Kabini	2001	1626
22.	Kethahalli	Kabini	2002	1113
23.	Madapura	Kabini	Not yet	928
24.	Madrahalli	Kabini	2001	1038
25.	Mugur	Kabini	2004	1133
26.	Nilasoge	Kabini	2002	1053
27.	Shambudevanapura	Kabini	2002	1700
28.	Thottavadi	Kabini	2004	1270
29.	Vatalu	Kabini	2001	858
30.	Yariyur	Kabini	Not yet	960

Source: Command Area Development Authority.

## APPENDIX 2. WATER USER COOPERATIVE SOCIETIES REGISTERED IN THE CAUVERY COMMAND AREA

Sl. No. (1)	Name of the Project (2)	No of societies with MOU signed during 2001 (3)	No. of identified WUCS (4)	No. of WUCS Registered (5)	No. of WUCS Regd. with 60 per cent membership (6)	Total M.O.U Signed till 2004 (7)
1.	K.R.S	20	158	158	39	39
2.	HEMAVATHY	18	210	179	49	49
3.	KABINI	12	128	124	64	64
4.	HARANGI	16	96	86	63	63
Total			592	547	215	215

Source: Command Area Development Authority, 2005.

## APPENDIX 3. WATER CHARGES FOR DIFFERENT CROPS SUGGESTED BY GOVERNMENT OF KARNATAKA

Sl.No. (1)	Crops (2)	Water charges/acre (Rs.) (3)
1.	Sugarcane	400
2.	Paddy	100
3.	Jowar, Maize, pulses, Tobacco	35
4.	Sunflower, Wheat, Horticulture crops, Cotton, Groundnut	60
5.	Bio-mass and green manure	15

Source: Command Area Development Authority, 2000.

APPENDIX 4

CROPPING PATTERN FOLLOWED IN THE HEAD AND TRAIL REACH OF THE WUCS SELECTED FOR THE STUDY  
(acres)

Sl. No. (1)	Annual/Seasonal crops (2)	Active WUCS						Active with Conjunctive water use- WUCS (CWUCSGG)						Passive- WUCS					
		Head Reach		Tail Reach		Head Reach		Tail Reach		Head Reach		Tail Reach		Head Reach		Tail Reach			
		Area (3)	Percentage to GCA (4)	Area (5)	Percentage to GCA (6)	Area (7)	Percentage to GCA (8)	Area (9)	Percentage to GCA (10)	Area (11)	Percentage to GCA (12)	Area (13)	Percentage to GCA (14)	Area (15)	Percentage to GCA (16)	Area (17)	Percentage to GCA (18)		
		30.4	50	30.4	50	30.4	50	30.4	50	30.4	50	30.4	50	30.4	50	30.4	50		
1.	Sugarcane	5.5	9.24	13.5	17.2	2	2.67	2	2.67	2	2.67	2	2.67	2	2.67	2	2.67		
2.	Tuberoase	5.5	9.24	12.5	15.9	1.5	2.01	1.5	2.01	1.5	2.01	1.5	2.01	1.5	2.01	1.5	2.01		
3.	Kharif crops	26.3	44.12	32.3	41.1	40.8	54.55	40.8	54.55	40.8	54.55	40.8	54.55	40.8	54.55	40.8	54.55		
4.	Paddy	23.75	39.92	31.3	39.8	39.3	52.54	39.3	52.54	39.3	52.54	39.3	52.54	39.3	52.54	39.3	52.54		
5.	Ragi	0.5	0.84	1.0	1.3	1.5	2.01	1.5	2.01	1.5	2.01	1.5	2.01	1.5	2.01	1.5	2.01		
6.	Tomato	2	3.36	1.0	1.3	1.0	1.3	1.0	1.3	1.0	1.3	1.0	1.3	1.0	1.3	1.0	1.3		
7.	Groundnut	22.3	37.39	19.3	24.5	30	40.11	30	40.11	30	40.11	30	40.11	30	40.11	30	40.11		
8.	Summer crops	1.25	2.10	7.0	8.9	17.5	23.40	17.5	23.40	17.5	23.40	17.5	23.40	17.5	23.40	17.5	23.40		
9.	Horsegram	16	26.89	10.8	13.7	3.5	4.68	3.5	4.68	3.5	4.68	3.5	4.68	3.5	4.68	3.5	4.68		
10.	Black Gram	3	5.04	0.5	0.6	9	12.03	9	12.03	9	12.03	9	12.03	9	12.03	9	12.03		
11.	Sunflower	2	3.36	2	3.36	2	3.36	2	3.36	2	3.36	2	3.36	2	3.36	2	3.36		
12.	Paddy	59.5	100	78.6	100	74.8	100	74.8	100	74.8	100	74.8	100	74.8	100	74.8	100		
13.	Tomato	187	308.52	172	271.2	175	284.25	175	284.25	175	284.25	175	284.25	175	284.25	175	284.25		
14.	Green manure	3	5.04	0.5	0.6	9	12.03	9	12.03	9	12.03	9	12.03	9	12.03	9	12.03		
15.	Ragi	2	3.36	2	3.36	2	3.36	2	3.36	2	3.36	2	3.36	2	3.36	2	3.36		
16.	Cowpea	2	3.36	2	3.36	2	3.36	2	3.36	2	3.36	2	3.36	2	3.36	2	3.36		
17.	Groundnut	2	3.36	2	3.36	2	3.36	2	3.36	2	3.36	2	3.36	2	3.36	2	3.36		
18.	Gross Cropped area (GCA)	60.8	100	78.6	100	74.8	100	74.8	100	74.8	100	74.8	100	74.8	100	74.8	100		
19.	Cropping Intensity (per cent)	200		187		175		175		175		175		175		175			

Note: The sugarcane area and tuberoase is doubled to calculate gross cropped area and the cropping intensity. This procedure is followed in standard agricultural economics literature.