THE IRRIGATION WATER RATE IN MENDOZA'S DECENTRALIZED AND PARTICIPATORY IRRIGATION ADMINISTRATION AN ANALYSIS

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1. INTRODUCTION

Ever since the General Water Law was passed in 1884, water administration in the Province of Mendoza (Argentina) has been decentralized and participatory. Regulated by Law No. 322 in 1905, it sets forth both the organization and the autonomy of the General Irrigation Department (DGI). On the basis of the water policy principles upheld in the Provincial Constitution (text corresponding to the third one, year 1894, section 9 on 'Water Regulation'), there developed in the province a true participatory management of water which, with slight changes, continues to this day.

Decentralization is based on the existence of a central administrative agency absolutely independent from the provincial Executive Power. In fact, the DGI prepares its own budget which, once pproved by the Administrative Tribunal, is collected through the irrigation water rate. This brings in genuine revenue which permits financial self-sufficiency and renders independent water management possible.

Users' participation takes place at different administrative levels --hence, the system's definition as participatory. At the first level, a users' representative of each of the oases in the province sits on the Administrative Tribunal, which assists the Superintendent in the administration of water resources by participating in the design of the sector's policy. The second level deals with river management. Here, for every river, an Honorary Users' Board, with representatives of the upper, mid and lower areas of the oasis, assists the Subdelegate. The third and probably the most important level corresponds to the autonomous and autarchic Water Users' Associations (WUAs), which elect their own authorities by direct vote, prepare and administer their own budgets, and collect irrigation water rates in their respective command areas. Their administrative structure is made up of an Inspector --or water judge of first instance--, three delegates, who assist the Inspector in all matters pertaining to water management, and gatekeepers, who are responsible for the actual delivery of water to the users.

During its first hundred years of operation, the above administrative scheme has experienced several changes. In its first stage, society was mostly agricultural and the irrigation system supplied all water uses, agriculture being the most important. At that time, there was a WUA for each canal, totalling almost 800 in the whole province. As society became more complex and water uses diversified, water management concentrated in larger organizations. In order to obtain economies of scale, a consolidation process of small associations into larger ones began in 1985 and ended in 1994. At present there are 157 WUAs.

This reorganization brought about greater management efficiency, profitable economies of scale, and the possibility of making investments in the irrigation system (Chambouleyron et al., 1995).

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The unification process of WUAs was followed by a federative process, i.e. the concentration of second-degree WUAs into what is known as Federation of WUAs. According to a project formulated by the DGI, this process, which began in 1992, would allow for better coordination and greater efficiency as regards water management.

This paper sets out to revise the mechanism for the calculation of the irrigation water rate in a specific number of WUAs in the oases irrigated by the Mendoza and Tunuyán rivers. The objective is to determine whether there is a relationship between the size of the WUAs, their budgets, and expense efficiency in order to formulate fair water rate payment policies.

To this end, a comparative analysis is made of the costs that the farmer has to defray for supporting the irrigation system. As the province has a unified system for the preparation of Expense Budgets and Financial Calculations for every fiscal year, and as budget appropriations are the same for all WUAs, it was possible to subject the different budgetary items to comparative analyses.

2. MATERIALS AND METHODS

The 1994 Expense Budgets and Financial Calculations were analyzed through a stratified sample representing the distribution per area of all WUAs in the Province. The WUAs belonging to the Mendoza and Tunuyán river oases were then selected, as they have the largest irrigated areas and the greatest diversification of water uses.

The sample is made up of 111 Water Users' Associations, of which 71 belong to the Mendoza River and 49 to the Upper and Lower Tunuyán River. Both, then, represent 70.7% of the provincial total (157).

These oases have different characteristics. The Mendoza River, a non-regulated river, supplies water to a densely populated urban and industrial conglomerate which causes water pollution and quality degradation problems along the irrigation system. Water is used for drinking water supply, power generation, industry and recreation, but not for agriculture. The Tunuyán River, on the other hand, is a regulated river. Although there are important urban centers and agricultural industries (food processing plants), water is mainly used for agriculture.

Table 1 - Water Users' Associations distributed according to oasis and size

Oasis	Area of the WUA (ha)						
	>1000	1000-3000	3001-6000	6001-9000	9001-12000	<12000	TOTAL
Río Mendoza	25	28	12	4	2	-	71
Lower Tunuyánr	7	7	6	1	3	3	27
Upper Tunuyán	4	5	2	1	1	-	13
TOTAL	36	40	20	6	6	3	111

Source: The authors, on data supplied by the DGI.

As shown in Table 1, smaller WUAs prevail in the Mendoza River oasis whereas larger ones prevail in the Tunuyán oasis. They all share the same management problems as regards both administrative-accounting and technical aspects.

2.1. Construction of the sample

The sample selected for analysis is made up of 31 WUAs stratified according to area so that they are representative of the associations making up the provincial total.

Stratification according to size responds to the initial hypothesis that this is a variable that determines the various degrees of efficiency in the management of the WUAs and, consequently, has a direct impact on the irrigation water rate.

The WUAs in the sample represent 19.7% of the provincial total. However, if only the oases of the Mendoza and Tunuyán Rivers are taken into account, the percentage rises to 28% .

2.2. Irrigation water costs in the Province of Mendoza

2.2.1. Canal cleaning

Mendoza's Water Law assigns the irrigation system users the responsibility for the regular maintenance of secondary, tertiary and quaternary canals in direct proportion to their registered area. In everyday language this is known as **limpieza de cupo** (cleaning quota).

This task is performed either by the users themselves or else by outsourcing, in which case it is paid directly by the users with no intervention of the WUA. This entails a cost for the users, which is calculated per hectare per year, as shown in Table 4.

2.2.2. Irrigation water rate (fee)

The irrigation water rate consists of two parts:

1) the canal pro rata

2) the DGI's budget

It may be defined as the 'total contribution made by farmers in *pesos*[5] per hectare and per year for irrigation water supply'. In other words, it is the cost of the service rendered by their respective WUA for operating and managing the irrigation system together with the service provided by the DGI for administering water at the oasis level. This means that the user has to pay to the DGI a given sum per hectare per year.

2.2.3. The canal pro rata

The pro rata is calculated by dividing the total expenses estimated for the fiscal year by the number of hectares of the Water Users' Association.

The total expenditures are included in the Expense Budget (Table 2), which is prepared every year by the Inspector and submitted to the Users' Assembly for approval. The Expense Budget is made up of the following items:

- **Personnel:**Amount to be paid to gatekeepers.
- **Canal cleaning and maintenance:** Expenses due to canal cleaning and maintenance during the cut-off period, repairs, quota cleaning by remiss users, machine-hours, and other outlays on the system's maintenance (Resolution No. 300 of the Honorable Administrative Tribunal-DGI).
- **Forestation**
- **Outsourcing:** Payments made to third parties for providing water distribution and other services which the WUA contracts directly, such as the construction and repair of bridges, intakes, flow dividers, gates, etc. This item varies greatly from one WUA to another as there is no uniform criterion for its determination.
- **Per diem and transportation:**Per diem and transportation expenses paid to the Inspector, the delegate, and the gatekeepers.
- **Maintenance and repairs of machines and vehicles:** It comprises those expenses relative to the maintenance of the WUA's vehicles and, to a lesser degree, the outlays on machinery and equipment repairs.
- **Contingencies**
- **Minor works:** Expenses due to canal lining, construction of bridges, flow dividers, gates, etc., and paid for by the WUA.

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[5] Rate of exchange: 1 (one) peso = US$ 1.

- **Machinery and tools:** Costs accrued from the purchase of new implements for daily work.
- **Books, stationery and office equipment**
- **Administrative fees:** Accountant fees and administrative personnel salaries (secretary, PC operator, etc.).
- **Banking expenses**
- **Incidental expenses**
- **Debts due from past fiscal years**
- **Debts to the DGI**
- **Publicity**
- **Contribution to the Federation of WUAs:** This is a new item; it is not included in all the Associations' budgets as the process of unification is not yet complete.
- **Hardware, software and communications**
- **Other**

2.2.4. The DGI pro rata (DGI budget)

It is calculated by dividing the DGI's annual budget by the total number of registered hectares.

Its main components are:

a) **maintenance fees:** They are paid by each and every one of the registered users in the province as a contribution to the DGI's operational expenses.

b) **dams maintenance fees:** They are the contribution paid for the maintenance of the dam from which each canal derives irrigation water.

c) **machine operation expenses:** They refer to the payment of the operating expenses of the equipment used in canal cleaning mainly (Herrera, 1992).

3. RESULTS ANALYSES

Table 3 includes the main outlays, areas, estimated collection percentages, and the irrigation water rate of all WUAs in the Mendoza and Tunuyán oases. Included next are other tables that have been prepared grouping the data in strata according to area.

Table 2 - Water Users' Associations. Province of Mendoza, Argentina

Expenses divided by items - 1994.

Expenditures in the 1994 - Fiscal year

Code	Water Users' Association	(01)	(02)	(03)	(04)	(05)	(06)	(07)	(08)	(09)	(12)	(11)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	TOTAL
1182	Canal Espino	0	345	0	1055	440	0	0	0		250	50	360	0	0	0	0	0	0	2500
1290	Hijuela Funés	3570	2430	.	150	0	0	0	0		0	0	350	500	0	0	0	600	0	8400
1183	Rama Valle Hermoso	0	3000	0	5850	2100	0	0	2000		660	35	320	0	0	0	0	900	0	14865
2130	Rama Henriquez		3500	0	3500	2400	0	0	1000		1800	600	350	1000	0	0	0	0	0	14350
1222	Hijuela Divisadero Centro y Sud	0	500	0	4450	1500	0	0	0		350	20	400	0	0	0	0	0	0	7220
1803	Hijuela Montenegro	5500	2000	0	500	700	0	0	0		350	0	350	0	200	0	0	2214	0	11814
1009	Hijuela Segunda Guiñazú	5000	2000	0	400	4200	0	0	1000		500	100	360	0	0	0	0	3755	0	27615
5014	Canal Rincón	4000	2100	0	1000	1200	0	0	500		500	200	400	600	0	0	0	0	0	19347
5740	Manantiales Tyan. Zona Centr	6000	1500	0	500	3000	0	0	100		300	200	400	100	0	0	0	2300	0	15600
1220	Hijuela Divisadero Norte	0	4000	0	6000	1800	0	0	700		1800	600	350	1000	0	0	0	0	0	16550
1281	Hijuela El Chilcal	0	1600	1000	3900	4800	0	0	1000		600	100	360	0	0	0	100	1400	0	14860
1285	Canal Lunlunta	0	3900	0	7240	6200	0	0	500		550	60	350	0	0	0	50	3400	0	30750
2137	Rama Godoy y Cauces Derivado	4700	5500	0	4600	3220	0	0	1000		1000	50	350	1950	0	0	150	0	0	25020
1070	Tajamar Unificada	0	17060	0	14729	14640	0	0	2000		1055	140	720	0	5000	0	0	7470	1600	65044
1003	Luján Centro Unificada	10000	6500	0	7000	13800	400	0	1000		800	200	500	3000	0	0	0	11370	0	57570
2598	Rama Nueva California	6890	10000	0	7000	4800	0	0	1000		1800	1200	350	1200	0	0	0	1800	0	37740
1231	Rama Marienhoff y Villa Cent	0	2500	0	6000	2000	0	0	500		400	100	500	0	0	0	0	0	0	13500
1242	Canal San Pedro y San Pablo	21500	19000	1000	33400	6500	4000	0	3000		3500	100	500	7200	10000	15000	500	1000	500	137700
2183	Cl.Mz.San Martín e Hij. Deri	13203	51500	5000	20000	15000	10000	0	3000		5000	6000	350	3500	0	0	0	1500	3000	147053
1237	Gustavo André Unificada	18000	12970	0	9530	6000	0	0	0		1800	100	500	500	0	0	500	1000	500	52900
5725	Arroyo Claro Unificado	7000	17000	0	1000	7000	2000	0	200		500	150	400	50	4000	0	0	7478	0	56978
2533	Canal Matriz Santa Rosa	0	5000	1000	10000	4000	0	0	500		2400	1000	350	2000	0	0	0	0	0	26750
1037	Rama Jarillal Unificada	13607	40650	0	10898	32560	9000	0	0		2000	200	360	6000	0	0	900	14025	4000	150000

Water Users' Associations. Province of Mendoza, Argentina

Expenses divided by items - 1994
(continued)

Code	Water Users' Association		Expenditures in the 1994 - Fiscal year																	
		(01)	(02)	(03)	(04)	(05)	(06)	(07)	(08)	(09)	(12)	(11)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	TOTAL
2140	Rama Chimba y Cauc.Der.Unif.	38000	25100	800	10400	19200	2200	0	5000		7200	2200	400	0	13000	7500	200	600	3000	137300
1736	Tulumaya Unificada	34210	10500	-1000	43000	10000	3000	0	0		2300	300	500	2460	0	0	0	12730	0	160000
1056	Mathus Hoyos Unificada	58049	41030	0	12080	35000	1800	0	9000		1000	1200	820	0	0	0	0	33225	0	242404
2397	Canales del Tramo Medio y C.	26000	34500	0	34000	9000	2000	0	2000		2400	700	400	5000	0	0	1000	0	4000	130000
2194	Rama Montecaseros y C.Deriv	95420	9000	200	5700	14400	2200	0	4500		2400	1000	300	0	0	0	1000	0	4000	146232
1118	Naciente-Chachingo Unificada	18000	28000	0	53000	28000	1000	0	5000		6000	1000	600	0	0	0	1000	20700	2000	169300
2123	Canal Matriz Independencia	0	56000	1000	1200	2400	600	0	2000		800	50	0	0	0	0	0	0	0	64850
2022	Canal Mz.Reducción y C.Deriv.	56000	28100	2000	16000	3500	9500	1000	8500		1200	150	350	1000	0	0	200	100	200	143800

Source: D.G.I., Mendoza

References:
(01) Personnel
(02) Canal cleaning and maintenance
(03) Forestation
(04) Outsourcing
(05) Per diem and transportation
(06) Maintenance and repairs of machines and vehicles
(07) Well operation and maintenance
(08) Contingencies
(09) Minor works
(10) Machinery and tools
(11) Books, stationery and office equipment
(12) Administrative fees
(13) Banking expenses
(14) Incidental expenses
(15) Debts due from past fiscal years
(16) Debts to the DGI
(17) Publicity
(18) Contribution to the Federation of WUAs
(19) Hardware, software and communications

Table 3 - Water Users' Associations. Province of Mendoza, Argentina

Expenses and resources - 1994

Code	Water Users' Association	Oasis	Area (ha)	Estimated Collection (%)	Total Expenses ($)	Total O&M ($)	O&M (%)	Canal Pro rata ($/ha)	DGI Pro rata ($/ha)	Rate ($/ha)
1182	Canal Espino	Mza	134	53	2500	2090	84	19.81	25.88	45.69
1290	Hijuela Funés	Mza	310	50	8400	6150	73	28.94	25.69	54.63
1183	Rama Valle Hermoso	Mza	439	70	14865	11610	78	17.01	26.12	43.13
2130	Rama Henriquez	T Inf	499	60	14350	11200	78	22.38	19.47	41.85
1222	Hijuela Divisadero Centro y Sud	Mza	555	65	7220	6800	94	12.99	39.55	52.54
1803	Hijuela Montenegro	Mza	557	45	11814	12100	44	29.89	32.75	62.64
1009	Hijuela Segunda Guiñazú	Mza	725	60	27615	8800	45	16.45	25.72	42.17
5014	Canal Rincón	T Sup	823	30	19347	11300	72	1.98	31.29	33.27
5740	Manantiales Tyan. Zona Centr	T Sup	1042	50	15600	13600	82	12.47	18.18	30.65
1220	Hijuela Divisadero Norte	Mza	1081	50	16550	10900	73	16.49	39.55	56.04
1281	Hijuela El Chilcal	Mza	1101	50	14860	9050	77	21.85	31.20	53.05
1285	Canal Lunlunta	Mza	1698	71	30750	17890	58	18.00	23.42	41.42
2137	Rama Godoy y Cauces Derivado	T Inf	1769	61	25020	19020	76	9.09	19.47	28.56
1070	Tajamar Unificada	Mza	2068	48	65044	47484	73	27.12	22.72	49.84
1003	Luján Centro Unificada	Mza	2219	60	57570	38100	66	20.20	25.00	45.20
2598	Rama Nueva California	T Inf	2252	50	37740	30490	81	24.60	19.45	44.05
1231	Rama Marienhoff y Villa Cent	Mza	2542	50	13500	10900	81	5.28	33.21	38.49
1242	Canal San Pedro y San Pablo	Mza	3422	50	137700	83900	61	33.00	26.35	59.35
2183	Canal Mz.San Martín e Hij. Deri	T Inf	3512	50	147053	104703	71	7.00	17.97	24.97
1237	Gustavo.André Unificada	Mza	3535		52900	48300	91	17.01	30.91	47.92
5725	Arroyo Claro Unificado	T Sup	3853	38	56978	32500	57	19.40	22.89	42.29
2533	Canal Matriz Santa Rosa	T Inf	3920	60	26750	21400	80	5.51	17.93	23.44
1037	Rama Jarillal Unificada	Mza	4840	55	150000	99715	66	30.01	25.72	55.73

Water Users' Associations. Province of Mendoza, Argentina

Expenses and resources - 1994

Code	Water Users' Association	Oasis	Area (ha)	Estimated Collection (%)	Total Expenses ($)	Total O&M ($)	O&M (%)	Canal Pro rata ($/ha)	DGI Pro rata ($/ha)	Rate ($/ha)
2140	Rama Chimba y Cauc.Der.Unif.	T Inf	5118	80	137300	99900	73	31.37	19.47	50.84
1736	Tulumaya Unificada	Mza	6365	70	160000	100010	62			
1056	Mathus Hoyos Unificada	Mza	6494	50	242404	147159	61	22.71	23.14	45.85
2397	Canales del Tramo Medio y C.	T Inf	7531	65	130000	105900	81	10.98	17.97	28.95
2194	Rama Montecaseros y C.Deriv	T Inf	9596	70	146232	126920	87	22.19	19.48	41.67
1118	Naciente-Chachingo Unificada	Mza	9692	70	169300	133000	79	15.10	26.42	41.52
2123	Canal Matriz Independencia	T Inf	10934	72	64850	60400	93	1.38	17.97	19.35
2022	Canal Mz.Reducción y C.Deriv.	T Inf	14160	60	143800	115600	80	10.01	17.69	27.70

Source: DGI, Mendoza

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3.1. Water distribution cost components

3.1.1. Canal cleaning

As shown in Table 4, the smaller the area of the Water Users' Association the higher the canal cleaning cost for the farmers. As users in small WUAs must bear higher costs, they are at a disadvantage with respect to the other users. In fact, users in WUAs having less than 1000 ha incur an average cost of $ 28, whereas those in WUAs with more than 6000 ha pay an average cost of $ 10.

Table 4 - Secondary and tertiary canal cleaning costs defrayed by farmers per workday per hectare [*][**]

WUA Area (ha)	Secondary and tertiary canal length (*)	Drain length (m/ha) (*)	Maintenance (days/ha)	Maintenance costs per farmer ($/ha)
Less than 1000	33	10	1,86	28
1000 to 3000	24	8	1,4	21
3001 to 6000	15	6	0.85	13
6001 to 9000	13	4	0,69	10
9001 to2000	12	3	0,58	9
Over 12000	12	3	0,68	9

(*) Wages: $ 15 per day.
(**) Chambouleyron et al., 1994.

Table 5 shows the average maintenance costs, as well as the pro rata of the canal and of the DGI; the irrigation water rate, and the total cost of the service. Columns 3 and 4 show a decreasing irrigation water rate due to high bureaucratic costs, which have a stronger impact on smaller WUAs. The same phenomenon is observed when analyzing the DGI's budget, which, once pro rated for all WUAs in the province, is considerably greater for smaller associations.

Table 5 - Average costs of irrigation services

	1	2	3	4	5
	CANAL MAINTENANCE	WUA PRO RATA	DGI BUDGET	IRRIAGTION WATER RATE	TOTAL COST
WUA Area (ha)	Average maintenance costs	Average canal pro rata (WUA's budget)	Average DGI pro rata (DGI budget)	Average rate (2 + 3)	Average total service cost 1+2+3 = 5
Less than 1000	28	28	28	56	84
1000 to 3000	21	16	26	42	63
3001 to 6000	13	25	23	48	61
6001 to 9000	10	26	21	47	57
9001 to 12000	9	13	21	34	43
Over 12000	9	10	18	28	37

N.B.:All values are given in $ per hectare per year, and they are averages weighted according to area.
Source:The authors, on DGI data and the WUAs' budgets.

In spite of the fact that all users are rendered the same service, column 5 shows variations in final service costs for those users belonging to smaller associations.

To reinforce this concept, Figure 1 is a graphic representation which links the items making up the irrigation service cost with the area of the WUAs.
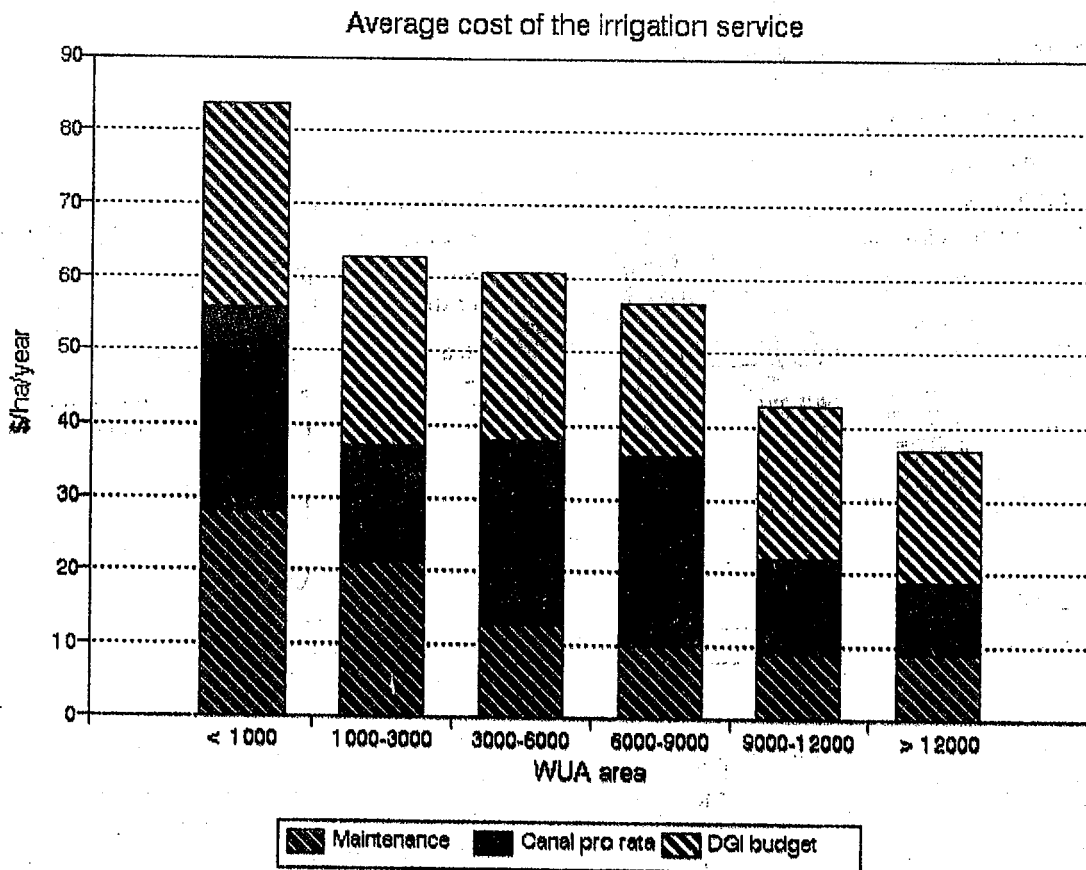
9

Average cost of the irrigation service

Legend: Maintenance | Canal pro rata | DGI budget

Figure 1

The IRRIGATION WATER RATE results from the total expenditures of both the WUAs and the DGI. Its higher for the smaller WUAs, in which bureaucratic costs have a weight greater than the investments (improvements). This conclusion, anticipated by Chambouleyron in 1992, can be verified by analyzing Table 8.

3.1.2. The DGI pro rata

The rate corresponding to the DGI budget, which in the smaller inspections exceeds $ 28 per hectare and in the larger ones is an average $ 20 ha/year (Table 5, column 3), is not used to improve the system but to defray the central agency's bureaucratic operational costs, which, as already stated, has taken up many of the activities formerly carried out by the WUAs.

Budgetary variations --prorated among all the WUAs-- do not respond to stratification by area. Neither can differences be ascribed to location in one oasis or the other. The question is whether the DGI rate --by definition, the Annual Budget divided by the number of hectares registered for all water uses in the Province-- should be the same for all WUAs, except, of course, for those cases in which works have been built and their cost reflected in the rate.

3.1.3. The canal pro rata

In the case of the canal pro rata (the WUA's budget), the only element apparently responsible for variations is the sum corresponding to the debts due from past fiscal years which the WUA expects to collect. This sum is sometimes 100% higher than the revenue collection estimated for the current fiscal year. As may be inferred from the budgets examined, the expected collection of those debts leads to a lower canal pro rata. Given the difficulties that collection entails (Table 6), calculating a lower pro rata could be interpreted as a political strategy on the part of the Inspectors.

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3.2. Revenue collection levels

The calculation of the canal pro rata is always based on an estimate of the annual expenditures incurred by the WUA. There are no variables from which to infer that the determination of expenditures, funds and pro rata is made on a rational basis.

An analysis of the budgets reveals that these WUAs are not financially self-sufficient since they do not collect the revenue they need and suffer recurrent crises (see the low collection levels expected, which on average reach 54% in inspections with over 9000 ha and 65% in the smaller ones; Table 6).

Table 6 - Average collection estimated for the present fiscal year (%)

WUA'S Area (ha)	Collection Percentage
Less than 1000	55
1000 to 3000	62
3001 to 6000	71
6001 to 9000	60
9001 to 12000	54
Over 12000	54

**Source: The authors, on data from the WUAs'
Financial Calculations.**

In view of this situation, Inspectors spend the money collected as overdue debts to cover the estimated expenses. However, they cannot make investments because they do not have enough funds. When they do manage to generate some savings or collect overdue debts, they adopt the policy of lowering the irrigation water rate per hectare instead of constructing works and making investments that would improve or, at least, keep the irrigation system in good conditions.

3.3. Operation and irrigation system management expenses

Canal cleaning (or maintenance) is the users' responsibility, and it is done according to their cleaning quotas. To calculate a farmer's cleaning quota, the canal length is divided by the total number of irrigation rights and multiplied by the area of his farm. The result represents the length of the canal he is to be clean.

Operation (O) includes the following activities: water distribution; distribution control; organizing the irrigation schedule (i.e., the rotation system according to which each owner may irrigate); and, in general, all related activities for which the Inspector --with the assistance of delegates and gatekeepers-- is responsible.

Irrigation system management (M) comprises the construction of works such as intakes, flow dividers, canal gates, and all minor works required for the conservation of the shared infrastructure. The cost of such works is included in the budgets under the item 'Outsourcing'.

The numerous items in the WUAs' budgets were classified in order to determine which are the most important outlays and how they are reflected in the total expenditures estimated for the fiscal year.

3.3.1. Composition of the O&M sector

After the different budget items were classified, it was detected not only that the amounts for the expenditures grouped under 'System Operation and Management' --listed above-- were appropriated to the fulfillment of the WUAs' essential goals but also that they were the most significant in the budgets. In fact, O&M expenditures (Table 7) represent on average 69.3% of the total outlays in the budgets analyzed.

The remaining 30.7% corresponds to minor expenses, usually of an administrative nature, incurred in support functions to the essential O&M. For instance: contingencies, banking expenses, debts to the DGI, publicity, office equipment, contribution to the Federation of WUAs, etc.

Table 7 - Composition of the O&M Costs of Water Users' Associations. Province of Mendoza, Argentina

O&M ITEM	% OF BUDGET
Personnel	15,39
Canal cleaning and maintenance	20.53
Outsourcing	16,52
Per diem and transportation	13,37
Administrative fees	3,45
Total:	69,26

Source: The authors, on data from the WUAs' budgets.

3.3.2. Structure of the O&M sector

This budget sector includes the items described below.

- **Personnel.** It comprises salaries, retirement and social security contributions for the WUA's permanent employees (gatekeepers and administrative staff). It represents 15.39% of the total budget, which is relatively low although this is not the only item under which personnel expenses are included: some inspections record them under 'System Cleaning and Maintenance'.

- **Canal cleaning and maintenance.** It includes the expenditures the WUA incurs to maintain those parts of the system neglected by the users who are responsible for them (quotas). It represents 20.53% of the WUAs' total expenditures. In theory, this percentage is later charged to remiss users (those who fail to perform the tasks indicated by the Inspector). In fact, it is included as expenditure in the budget, thus having an impact on the rate paid by all irrigators.

- **Outsourcing.** It represents the money invested in maintenance, i.e. lining, construction of intakes, flow dividers, and all other activities required to improve the irrigation system. Its relative weight is very low: 16.52% . This not only shows that investments in improving the existing infrastructure are insufficient but also points to its state of deterioration.

- **Per diem and transportation expenses.** This item represents some 13.4% of the WUAs' budget. If compared with the percentage allotted to system maintenance (16.5%), it is very high and points to the fact that the Inspector's position is not completely honorary. It is a considerable portion of the expenses which are reflected in the canal pro rata. Table 8 presents the weight this item has in comparison with the total expenses incurred by the WUAs.

Table 8 - Percentage of 'Per Diem and Transportation Expenses' costs in comparison with total budgets

WUA'S Area ha	Total expenses ($)	Total per diem and transportation	%
Less than 1000	106.111	12.540	12
1000 to 3000	276.634	54.260	20
3001 to 6000	707.981	80.660	9
6001 to 9000	532.404	54.000	10
9001 to 12000	380.382	47.800	13
Over 12000	143.800	3.500	10

Source: The authors, on data from the WUAs' budgets.

3.3.3. O&M and the WUAs' budget

As seen in Table 9, the costs of O&M items, defined above, represent on average about 82% of the budgets of the WUAs of larger relative area --i.e., over 9000 ha. In the smaller ones, 1000 to 3000 ha, O&M totals 68% of the budgeted amounts. The difference, more than 12%, shows that administrative costs have a higher incidence on the smaller WUAs.

Table 9 - Average O&M costs in all WUAs' budgets

WUA'S Area (ha)	Average O&M costs ($)	Average O&M costs (%)
Less than 1000	8.756	66
1000 to 3000	21.937	71
3001 to 6000	70.059	69
6001 to 9000	117.690	66
9001 to 12000	106.773	84
Over 12000	115.600	80

Source: The authors, on data from the WUAs' budgets.

An example of what has been stated is shown by item 'Contribution to the Federation of WUAs' (Table 2, column 18). Its weight is greater in smaller inspections: some 19% of the total budget of inspections having between 1000 and 3000 ha. In those of larger relative area it amounts to 11% . In all cases, this item constitutes an additional cost to the users --this being the reason why larger inspections are still reluctant to join the Federation (Chambouleyron et al. 1995).

Item 'Minor Works' has very little incidence on the budgets analyzed (Table 10). It is most significant that 58% of the WUAs in the sample have not even contemplated this type of investments, a fact which further contributes to the physical deterioration of the irrigation system.

Table 10 - Investments in minor works as a percentage of the total WUAs' budgets

Hectares	%
Less than 1000	11,1
1000 to 3000	6,5
3001 to 6000	4,7
6001 to 9000	2,6
9001 to 12000	2,3
Over 12000	10,0

Source: The authors, on data from the WUAs' budgets.

There are no items and/or expenditures from which to infer that investments in minor works are being made.

3.4. Performance parameters in a decentralized and participatory irrigation administration

The irrigation water fee has been defined, and its structure and components analyzed. The collection levels attained by the different WUAs open up, one way or the other, the possibility of an efficient management as they represent the WUAs' means to operate and manage the irrigation network.

The management performance of each association can be assessed by measuring collection levels. To this end, a number of performance parameters has been defined and justified (Bos, M. et al., 1995).

The development and verification of such parameters call for systematic and steady research in different periods of time to ascertain and adjust every one of their values. The idea, at this stage, is to demonstrate the applicability of the so-called 'social viability' indicators, which have been discussed at a theoretical level.

They comprise administrative indicators of the WUAs' financial capacity, administrative management, as well as an assessment of their capacity for self-management.

In a preliminary research, only 5 (five) WUAs were analyzed. Each of them represents one stratum belonging either to the Mendoza or to the Lower Tunuyán oases (Table 11).

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Tabla 11 - WUAs under study

WUA	Area (ha)	River
Montenegro	less 1000	Mendoza
Medrano	1000 to 3000	Tunuyán
Norte Alto Verde	3001 to 6000	Tunuyán
Montecaseros	6001 to 9000	Tunuyán
Reducción	over 9000	Tunuyán

3.4.1. The administrative performance parameter (APP)

It is the ratio between the actually collected amount and the theoretically collectable amount as a function of the register in accordance with the legislation in force. It can be described as:

APP = (Current year's water rights + Previous years' water rights/Total WUA's water rights

The denominator, what each WUA expects to collect, is obtained by multiplying the total number of registered hectares times the canal pro rata. The numerator is formed by adding together the amount collected in the current fiscal year at the corresponding fee and the debts due from past fiscal years.

This parameter measures administrative efficiency according to the amount collected as payment for irrigation water services. The APP optimal value should be close to 1. The values calculated for the WUAs in the sample are shown in Table 12.

Table 12 - Administrative performance parameters

WUA	Area (ha)	APP
Montenegro	557	0,36
Medrano	2900	0,95
Alto Verde	5533	0,68
Montecaseros	9596	0,75
Reducción	13000	0,63

This table shows that only the Medrano WUA has an APP close to the optimal value, followed by the Montecaseros and Norte Alto Verde WUAs.

Payment arrears undoubtedly have a strong impact on the parameter, which --in turn-- is a clear indication of the users' economic and financial situation.

Here follow some comments explaining the difficulties arising from the definition and subsequent application of the APP to the current situation:

- Pro rata estimated on the basis of historical data.
- Obsolete Users' Registers.
- In most cases, lack of precise information on the actually irrigated area.
- Inspectors always 'estimate' the collection of debts due from past fiscal years. This points to the incomplete decentralization of the administrative-accounting and financial functions transferred from the DGI to the WUAs.

3.4.2. Financial viability of the irrigation system

Concerning the decentralized WUAs' financial aspects, the following three complementary parameters are proposed:

3.4.2.1. Total financial viability

It is the ratio between the amount actually allocated to cover operation and maintenance expenses and the amount really required for those activities.

Total financial viability = Actual O&M Allocation/Total O&M Requirements

This indicator shows the degree of ease and/or difficulty with which a WUA meets the expenses incurred under its most important item. Table 13 shows the values obtained in the sample of WUAs analyzed.

Table 13 - Total financial viability (FV)

WUA	FV
Montenegro	0,46
Medrano	0,58
Norte Alto Verde	0,61
Montecaseros	0,69
Reducción	1,25

Also in this case the optimal value is 1, which is achieved by those WUAs that self-finance all of their O&M expenditures. The WUA representing the smallest area stratum has the lowest index (0.46). The Reducción WUA's value points to an erroneous calculation.

3.4.2.2. Financial self-sufficiency

This parameter is used to clearly determine a WUA's capacity to cover the expenses derived from the system's operation and water distribution with genuine funds.

The numerator is obtained by multiplying the WUA's number of hectares registered for all water uses times the value of the canal pro rata expressed in pesos per ha ($/ha). The denominator is the total funds required to finance the operation and management costs of the WUA's canal system.

It is expressed as follows:

Financial Self-Sufficiency = Actual Income/Total O&M Requirements

Table 14 shows the values obtained for the WUAs in the sample:

Table14 - Financial Self-Sufficiency

WUA	FSS
Montenegro	0,41
Medrano	0,68
Norte Alto Verde	0,54
Montecaseros	0,78
Reducción	0,67

The optimal value is 1. In practice, however, it is about 0.7, which shows that the income is not sufficient to defray the expenses incurred in water distribution, and much less make investments. In two WUAs, the indicator shows a value close to 0.5, which reinforces the hypothesis that the current conditions, aggravated by low productivity levels, strongly condition the collection levels in the system.

3.4.2.3. Performance of the canal pro rata (fee)

It is expressed as follows:

Performance of Canal Pro Rata = Irrigation Rates Collected/Irrigation Rates Due

This parameter shows the total income paid by the farmers in a given year as canal pro rata (numerator) divided by what the WUA expects to collect at the moment of preparing the budget.

In practice, the WUAs do not have other genuine income and, moreover, they have high percentages of farmers in arrears. The numerator is always smaller, which shows that the amounts collected are low when compared with the theoretical collection level calculated on the basis of the Users' Register used. As can be seen in Table 15, only one WUA, with over 9000 ha, has reached a

value higher than 0.7 and has a relatively high efficiency level --though still quite distant from 1, which would be the optimum in a financially well-ordered WUA.

Table 15 - Fee colelction performance

WUA	FCP
Montenegro	0,41
Medrano	0,62
Norte Alto Verde	0,53
Montecaseros	0,75
Reducción	0,60

3.4.3. Sustainability of the irrigable area

It is a global parameter used in planning and monitoring a WUA's overall management.

It is defined as follows:-

Sustainability of Irrigable Area = Current Irrigable Area/Initial Total Irrigable Area

Again, it is worth noting the importance of updating both the registered area and the actually irrigated area.

Table 16 shows the values for this indicator as obtained from the sample.

Table 16 - Environmental sustainability and drainage

WUA	SI
Montenegro	0,48
Medrano	0,90
Norte Alto Verde	0,60
Montecaseros	0,61
Reducción	0,60

The low values obtained are largely due to the fact that most WUAs do not know exactly how many properties have been abandoned, subdivided, or else have changed from agricultural to urban or urban-industrial soil use.

The water effectively distributed for irrigation purposes is reflected in the indicator values. In three of the WUAs under study, it is 0.6. The Medrano WUA shows a high value (0.9) for this parameter --a more efficient water distribution according to availability and users' needs-- as a result of having updated its register and of using real data on agricultural and urban properties.

3.4.4. Summary of results

The differences between the amount really collected and what the WUAs expect to collect show that there is a large number of irrigators in arrears. This is partly due to the fact that their calculations are based on obsolete Users' Registers.

The values of the sustainability indicator, as well as those of financial self-sufficiency and viability, are about 0.7. This means points to a similarity between the number of actually irrigated hectares and the 'active' registered properties with water rights.

The items in the budgets that the WUAs prepare according to DGI directives are excessive and complex. However, in everyday management, they are in fact reduced to what has been identified as 'system operation and maintenance'. The amount collected hardly suffices to cover this set of items; and this only for the actually irrigated properties which pay the irrigation fee rate.

Table 17 - Summary of results

WUA	Area (ha)	Parameters				
		APP	FV	FSS	FCP	SI
Montenegro	557	0,36	0,69	0,41	0,41	0,48
Medrano	2900	0,95	0,58	0,68	0,62	0,90
Norte Alto Verde	5533	0,68	0,61	0,54	0,53	0,60
Montecaseros	9596	0,75	0,69	0,78	0,75	0,61
Reducción	13000	0,63	1,25	0,67	0,60	0,60

4. CONCLUSIONS

4.1. Critical aspects of the administrative system

In theory, the irrigation administration in the Province of Mendoza is an orderly system organized according to guidelines provided by the DGI; its uniform system for recording expenditures and resources makes it possible to compare the WUAs' management performance and, thus, to conduct a critical analysis of the whole. It is the product of a 20-year-old process by which the DGI has been taking over functions formerly discharged by the WUAs (Chambouleyron et al., 1995).

However, deeper analysis of the administrative system reveals a number of inequities borne especially by the users who comply with their obligations: canal cleaning and regular payment of the irrigation water rate to the DGI. The fulfillment of these obligations has permitted the continued operation of the central agency and of the respective WUA in charge of distributing and managing water.

The total (final) cost of irrigation water shows large differences when the area of the WUAs is taken into consideration: the smaller ones bear higher costs.

In addition, the system, conceived more than 100 years ago, is by definition highly participatory. Participation --the users' real protagonism in their respective WUA's management-- decreases when the number of administrative levels increases. This is the case of the WUAs which have joined the Federation as now there are four administrative instances: the WUA, the Federation, the respective Subdelegation, and the DGI.

Though in theory this should render the system more efficient, the fact is that it excludes individual users from the places where decisions are taken.

Moreover, it has a remarkable secondary effect in that it increases bureaucratic costs due to the need to pay for the operation of the new administrative levels. Again, the smaller WUAs bear the heavier burden, a fact which aggravates their economic condition in a context of increasing difficulties. For example, as already pointed out, the item **Contribution to the Federation of WUAs** is a new expenditure increasing the WUAs' budgets.

4.2. A proposal for budgetary management

In view of the above, it is herein proposed to analyze the administrative costs of Mendoza's irrigation system in depth in order to reduce them to the minimum required for its efficient operation. This will mean reducing the present number of administrative instances to truly decentralize functions to the WUAs, as stipulated in the legislation in force.

Besides, the DGI's bureaucratic costs should have the same relative weight for all irrigators, i.e., those in small WUAs as well as those in the larger ones.

It is necessary to revise the present budgetary system in order to re-design the WUAs' Expense Budget and Financial Calculations. The current scheme, which is imposed by the DGI, is highly complex and contains an excessive number of items: 19. Budget items should be reduced to the most important management aspects: 1) personnel, 2) system repairs and maintenance, 3) minor works, 4)

purchase and repairs of machines and vehicles; 5) fees for special services (administrative and technical), 6) office equipment and expenditures, and 7) communications. In this way, it would be possible to eliminate many of the budget items that either have insignificant appropriations or no appropriation at all.

4.3. A proposal to improve collection and participation levels

The budget scheme suggested above should be easier for the users to understand; it should enable them to evaluate the expenditures anticipated for the current fiscal year and the way they are to be met. In short, this will facilitate the effective participation of the users, who are the ones who finance the system.

According to historical data, collection levels reach only between 50% and 60% of the total (Chambouleyron et al., 1995). This shows, firstly, that users' participation is weak --and this is the basis of the irrigation system-- and, secondly, that the WUAs are unable to invest in the irrigation system's maintenance and improvement. Thus, a vicious circle is formed bringing about the system's deterioration, dissatisfaction, less participation on the part of the irrigators, and further deterioration.

Motivating users to participate and fulfill their obligations will most likely depend on proposals with stronger emphasis on infrastructure and system management investments rather than on bureaucracy. This could be achieved through the permanent discussion and programming of the necessary works, which should be selected according to the priorities identified by the users themselves during the Assemblies.

In this way, the WUAs' budgets and the corresponding pro rata will be applied to the essential activities which the provincial Constitution and the Water Law assign to the WUAs: maintain, improve and administer the irrigation system, and distribute water with equity and efficiency.

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