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WATER GOVERNANCE AND MANAGEMENT IN THE WATER USERS' ASSOCIATIONS OF SPAIN

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SUMMARY - The long irrigation tradition in Spain excelled during the time of the Arabs, who introduced new techniques and the concept of collective management in the governance of the irrigation water. More recently, water legislation has had two landmarks, almost a century apart: the Law of 1866-1879, and the Law of 1985. The fact that it took almost a century to change the 1879 Law, is indicative of an old tradition and of resistance to change. The water users' associations in Spain are firmly based on the effective structures that were developed more than seven centuries ago. Therefore, the new irrigation policies are directed towards the modernization of infrastructures rather than towards institutional reforms. On the other hand, researchers and engineers are emphasizing the need for developing assessment tools as part of the modernization plans. The irrigation networks are facing the dilemma of introducing new and costly changes in the physical infrastructure against introducing management tools for assuring irrigation sustainability, with changes in the physical infrastructure as a secondary option. In this paper are summarized the structure and organization of the water users' associations in Spain and, then, are presented two cases where an analysis of water use and of irrigation performance was carried out using newly developed tools.

Key words: water users' associations, irrigation water management.

INTRODUCTION

The long irrigation tradition in Spain probably started with the first migrations from Eastern Mediterranean, but it excelled during the time of the Arabs, who introduced not only new techniques, but also the concept of collective management in the governance of the resource. The current Water Court of Valencia, which arbitrates water conflicts among users and is composed by user's representatives, dates its origin to the times of the presence of Arab kingdoms in the Iberian Peninsula. More recently, water legislation has had two landmarks, almost a century apart: the Law of 1866-1879, and the Law of 1985. The fact that it took almost a century to change the 1879 Law, is indicative of an old tradition and of resistance to change. Nowhere is that tradition stronger that among Spanish irrigationists.

The actual organization of the water users' associations in Spain is firmly based on the effective structures that were developed more than seven centuries ago. Therefore, it is not surprising that the current irrigation policies are directed towards the modernization of infrastructures rather than towards institutional reforms. Given that the current level of knowledge about the functioning of irrigation networks is insufficient, researchers and engineers are emphasizing the need for developing management and assessment tools as part of the modernization plans. The quest for the modernization of established irrigation networks, such as those in use in Spain, must seek a balance between the investments in the improvement of physical infrastructure and the investments needed for improving water management. Infrastructure improvements are often needed for irrigators to take full advantage of new technological developments, such as micro-irrigation or off-season crop production. The development of management tools and of information systems required for the sustainable management of water at the farm and network scales, is equally critical for the improvement of water productivity. Irrigation management in the future will be based on the development of an optimal solution to the site-specific problem of balancing infrastructure and management improvements. At present, there is a tendency of overemphasizing infrastructure investments at the expense of those needed for improved management.

In this paper firstly are summarized the structure and organization of the water users' associations in Spain and, then, are present two cases where an analysis of water use and of irrigation performance was carried out using newly developed tools.

ORGANISATIONAL STRUCTURE OF THE SPANISH WUAs[7]

The central feature of the WAU's in Spain is their participatory nature. Water users have participated in the management and administration since long ago, and, in return, the legislation has attributed to the WAUs the character of public corporations. Such characteristic allows the WUAs to impose water charges and to prosecute those that do not meet the payment deadlines.

The typical organisational structure of a WUA in Spain includes (Fig. 1):

- a general assembly,
- an executive board,
- a manager and
- the operation, maintenance, administrative and financial departments.

The *general assembly* is composed of all the farmers of the association, thus it is the highest authority. Its main function is to select the executive board, to approve or disapprove the management plans, and to vote on important issues. The general assembly has a president, a vice-president and a secretary.

The *executive board* supervises and directs the execution of the work approved by the assembly, prepares management plans, budgets and reports annually, selects officers and establishes policies. The number of members of the board varies with the size and complexity of the scheme from three to about fifteen. The board has a president, a vice-president, a secretary and a treasurer (usually the president and the vice-president of the board are also the president and vice-president of the general assembly). The president represents the association. It is of his/her competence to call, set the time and place, preside and moderate the executive board meetings, and to sign the board minutes. The vice-president will substitute the president in case of absence or vacancy. The secretary is in charge of preparing the minutes of the board meetings, keeping records of the board agreements, custody the official documents, file official board correspondence, and communicate the president calls and orders and the executive board agreements. The treasurer is responsible for the association's assets, for the disbursement of the association funds, and for providing advice on the annual budget.

The *manager* is directly responsible for the day-to-day work according to the mandate of the executive board; he/she is also in charge of directing the annual planning and budgeting process, formulating the work programs, supervising and monitoring the staff, monitoring the scheme performance, identifying problems, communicating with other agencies on behalf of the scheme, recommending policy changes to the executive board. The number and complexity of the departments below the manager depend on the scheme complexity, i.e., the acreage and the number of farmers in the scheme.

Consultants are hired when a service on a specialised field is necessary but it is not justified hiring a full-time professional. Also consultants are hired for solving problems beyond the capability of the regular staff, for annual financial auditing, or for legal advise. Regarding the legal advise, the WUAs in Spain usually have adequate advice to ensure compliance with applicable laws to reduce prospects from adverse legal action against the association, for reviewing contracts, and to ensure that water rights are maintained legally sound.

[7] This section has been extracted from Mateos and Sagardoy (2004) and Sumpsi et al. (2003)

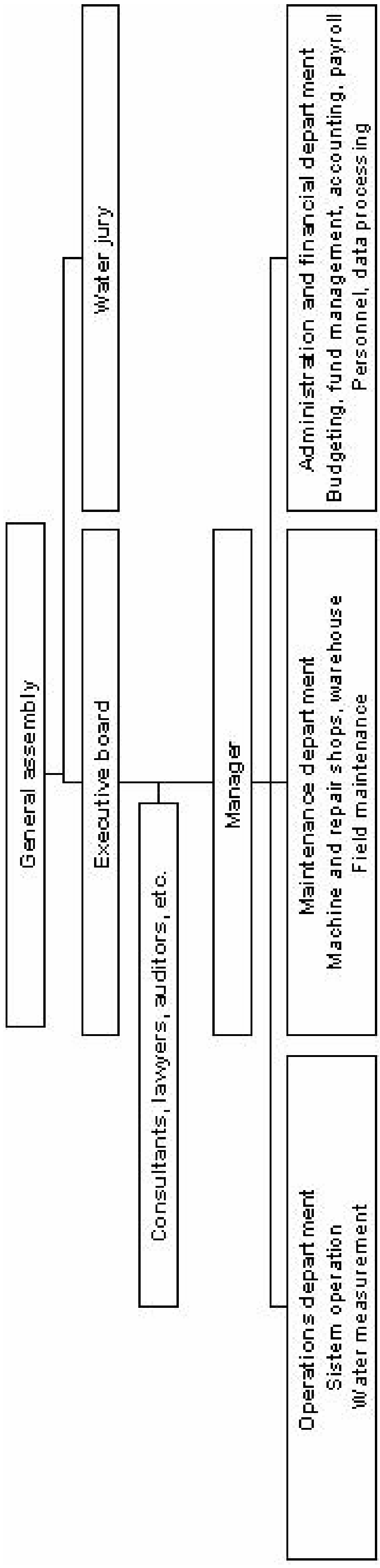
General assembly
Water jury
Executive board
Consultants, lawyers, auditors, etc.
Manager
Administration and financial department
Budgeting, fund management, accounting, payroll
Personnel, data processing
Maintenance department
Machine and repair shops, warehouse
Field maintenance
Operations department
Sistem operation
Water measurement

Fig. 1. General organisational structure of a water users' association in Spain.

An institution characteristic of the Spanish WUA is the *irrigation jury*. The jury has capability to punish faults against the set rules and regulations. The jury is selected from members of the board or elected by the general assembly.

TWO EXAMPLES OF ORGANISATION AND WATER MANAGEMENT IN SOUTHERN SPAIN

Description and organisation of the BXII irrigation scheme

The BXII irrigation scheme is located in Southern Spain. It covers about 14,000 ha of reclaimed land. Irrigation started in the late 1970'. The area is divided in 1142 farm units of 12 ha on average. Climate is Mediterranean, with dry and hot summers and wet and mild winter and autumn. The soils originated from the fine sediments of the river Guadalquivir in its final lot, and have high clay content and low content of sand. An artificial drainage system controls the groundwater level and permits salt leaching. The main crops are cotton, sugarbeet and winter cereals. The irrigation water is provided by a canal termed "Canal del Bajo Guadalquivir". Sprinkler and furrow irrigation are the predominant irrigation methods.

The farmers are associated in an Irrigation Association with a president and a vice president, who occupy the same charges in the general assembly and in the executive board. The general assembly is integrated by the landowners of the scheme. The number of votes per landowner is proportional to the size of his/her property, corresponding one vote to farm units between 1 and 20 ha and two votes to the farm units larger than 20 ha. Smaller properties can be associate to obtain a number of votes corresponding to their size.

The general assembly meets once a year (Fig. 2). Every four years it elects the president and vice president of the executive board plus 13 more members. President and vice-president are renewed every four years. Half of the members of the board are renewed every two years, thus the members stay in the board for four years. The irrigation jury is also assigned by the general assembly. The president must be an officer at the executive board; the other four members are elected among the electorate. In addition to the election of the board members and irrigation jury, the assembly approves the budget for the next year and discusses and votes important issues concerning the scheme. The executive board elects a treasurer and a secretary among the officers. The secretary assigns a vice-secretary. Also the manager participates in the board with voice but without vote. The legal advisor appointed by the board is also requested to attend the board meetings.

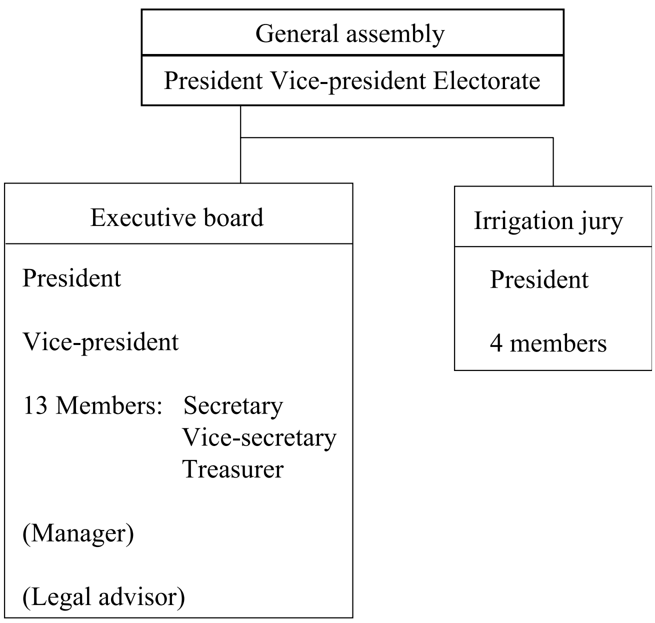

Fig. 2. Organisational structure of the BXII Irrigation Association

Each of the 13 officers of the board represents each of the 13 sectors of the scheme, i.e., they are elected by the landowners of the corresponding sector. Each sector has its own board integrated by the elected officer of the executive board and the second most voted landowner standing for the board at that sector. The sector board has to watch for the proper use and maintenance of the sector, including the pumping station, and has to define the water delivery schedule within the sector.

Water delivery scheduling in the BXII irrigation scheme[8]

When water demand is low, the system works on-demand, although some arrangements among the farmers of each section may be required. As the summer approaches, water demand increases significantly, on-demand scheduling is not possible anymore, thus the water delivery schedule switches to a fixed rotation. The manager, based on experience, decides the exact time of the switch. The rotation (within each section) has duration of 8 days. For a section with four farms of equal size, the duration of a turn is two days. In any case, the duration of the turn is proportional to the relative area of the farms in the section. This water delivery schedule will be called from now on WDS-A.

An alternative delivery schedule that was simulated in the 2001-02 irrigation campaign using SIMIS (the FAO Scheme Irrigation Management Information System) (Mateos et al., 2002) is a fixed rotation with applied depths computed from gross irrigation requirements. This delivery schedule will be called WDS-B. The advantage of WDS-A vs. WDS-B is that WDS-A is equitable. Figure 3 represents Equity of Supply sector by sector in two rotation periods (21/03-28/03 and 21/04-28/04). It can be observed that, as the maximum demand approaches, WDS-B becomes more equitable, but it cannot reach the value obtained with WDS-A (one by definition). The advantage of WDS-B is that it should make much better use of the available water.

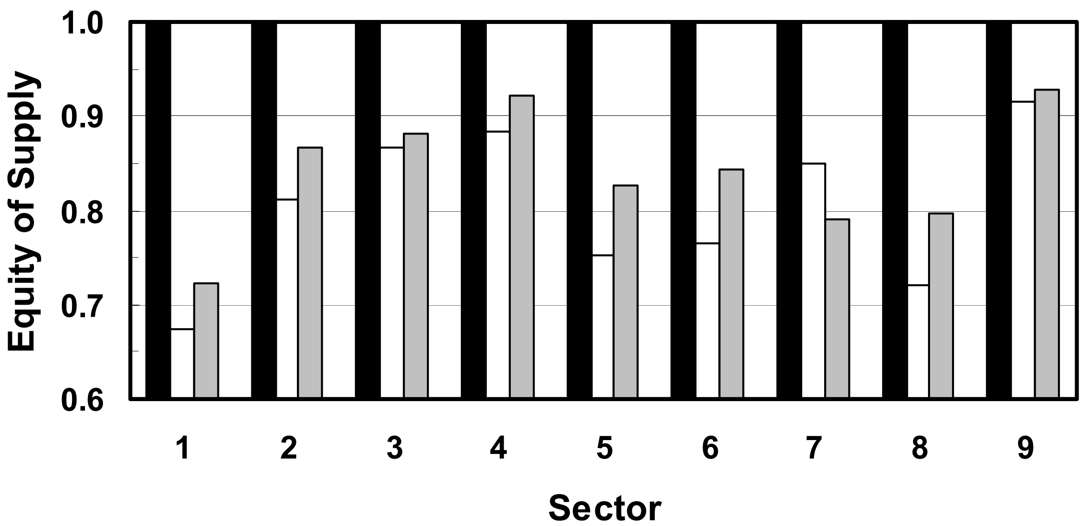

Fig. 3. Equity of Supply in the sectors of the BXII irrigation scheme. Campaign 2001-2002. Black bars: WDS-A. White bars: WDS-B 21/04/2003 to 28/04/2003. Grey bars: WDS-B 11/06/2003 to 18/06/2003.

[8] This section has been extracted from Lozano et al. (2003).

The simulation with SIMIS showed that from the rotation period 11/05–18/05 on, the time required for WDS-B exceeds in some sections the 192 hours (8 days) established for the rotation. This situation is basically maintained until the rotation period 21/08-28/08. Therefore, from 11/05 to 28/08 WDS-B is not possible in some of the sections in the scheme. Before and after those dates WDS-B is feasible all over the scheme. But an important corollary of this reasoning is that irrigation may be insufficient during certain periods in the irrigation season. Therefore, the Relative Irrigation Supply was checked for the WDS-A in the period during which WDS-B is unfeasible. The calculation of the Relative Irrigation Supply in the 11/06-18/06 period showed that a number of farms suffered insufficient water supply in that scheduling period. When analysed in other periods, the Relative Irrigation Supply under WDS-A indicated that excess of water is applied before the peak demand occurs, and that sector-averaged deficit irrigation is not relevant even during the peak demand (Fig. 4).

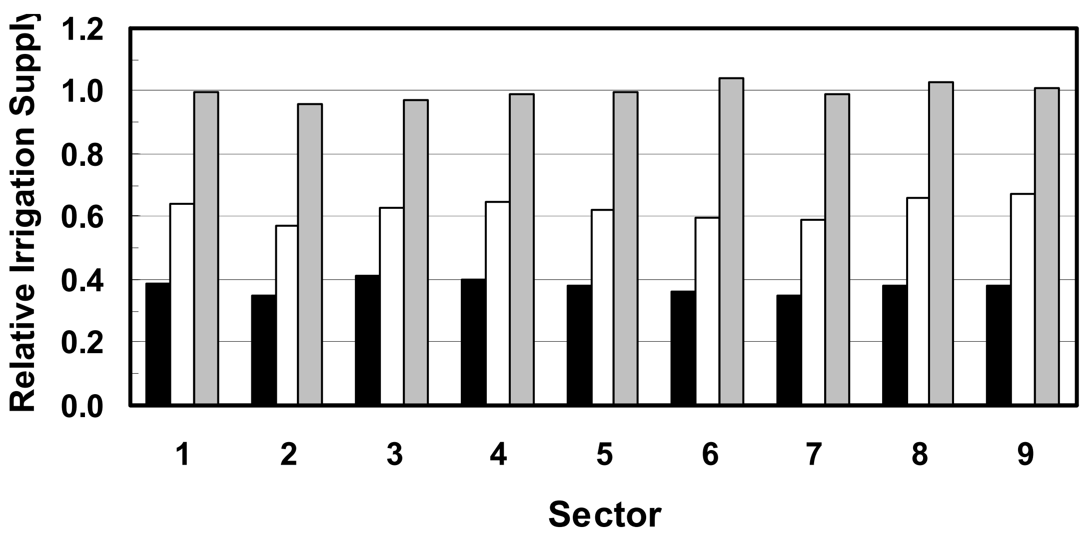

Fig. 4. Relative Irrigation Supply in the sectors of BXII irrigation scheme with a fixed rotation of 192 hours. Black bars: 21/03/2003 to 28/03/2003. White bars: 21/04/2003 to 28/04/2003. Grey bars: 11/06/2003 to 18/06/2003.

In order to identify the causes of slight deficit irrigation during peak demand, the Water Delivery Capacity was examined. It was found that the Water Delivery Capacity of the hydrants was everywhere greater than 1, thus the limitation was not at the farm inlets. The Water Delivery Capacity of the sector pipes was also greater than 1. However, the Water Delivery Capacity was less than 1 in several sections. These sections coincide with the sections where Relative Irrigation Supply values greater than one were detected, indicating that the size of some section pipes is the cause of localised insufficient water supply during peak demand.

Description of the Genil-Cabra irrigation scheme

The scheme is near the town of Cordoba, Southern Spain. The area that was evaluated encompasses 6,989.4 ha of irrigated land and was developed around 1990, being under full water supply since 1995. The climate is Mediterranean continental with an annual average precipitation of 606 mm, and a rainless summer. The most important crops in the area are winter cereals, sunflower and cotton. Other relevant crops in the area include garlic, olive, sugar beet, beans, maize, and several horticultural crops.

The area is serviced by a modern pressurised irrigation delivery system, which allows complete flexibility of frequency, rate and duration of water delivery. The area is divided into command areas. Each command area is composed of one or more plots depending on the size of the plots. There are

290 plots of less than 2 ha, occupying 4.3% of the area, about 360 plots are between 2 and 10 ha, representing 22.6% of the area and 190 plots are between 10 and 100 ha (65.7% of the area). Three command areas serve farms that are over 100 ha, occupying 8.5% of the area. Thus, over 90% of the plots have an area less than 20 ha.

The farmers in the Genil-Cabra are associated in an irrigation association that follows the structure described above and it is similar to that of the BXII irrigation scheme.

Irrigation performance assessment of the Genil-Cabra irrigation scheme[9]

Between 1996 and 2000, a comprehensive assessment of the irrigation performance of the Genil–Cabra irrigation scheme (GCIS) had been conducted. Six performance indicators were used to assess the physical and economic features of irrigation water use and management in the Genil-Cabra irrigation scheme, using on-farm water use information and a simulation model. The model simulates the water balance processes on every plot and computes an optimal irrigation schedule, which is then checked against actual schedules. Among the performance indicators, the average irrigation water supply-demand ratio (the ratio of measured irrigation supply to the simulated optimum demand) varied among years from 0.45 to 0.64, indicating that the area is under deficit irrigation. When rainfall was included, the supply-demand ratio increased up to 0.87 in one year, although it was only 0.72 in the driest year, showing that farmers did not fully compensate for the low rainfall with sufficient irrigation water. The average values for all performance indicators had large coefficients of variation (the CV of average irrigation water supply-demand ratio varied between 0.61 and 0.87) due to substantial plot to plot variations in water use and management. Water productivity in the Genil-Cabra irrigation scheme oscillated between 0.7 and 2 €/m^3 during the four years and averaged 1.42 €/m^3 of water supplied for irrigation, while the marginal water productivity averaged 0.63 €/m^3 for the period studied.

Performance indicators based on the water balance detected two water management strategies depending on the crop; cotton, garlic, maize, and sugar beet had average ratios of measured irrigation supply to the simulated optimum demand, ranging between 0.7 and 0.9. Winter cereals, sunflower and olive had much lower average ratio, ranging from 0.28 to 0.39. However, the distribution of water use among the various plots for each crop showed large variations in water use in all cases. For instance, in cotton, even though the average ratio was around 0.8, about 50% of the plots were not irrigated adequately (41% with deficit and 9% excessive).

Water productivity (WP) in the GCIS was highest for the horticultural crops (garlic and olive; from 1.13 to 6.52 €/m^3) while it varied among the field crops, being lowest in maize (0.28 €/m^3) and highest in sugar beet (1.04 €/m^3). Large year to year variations in WP were observed in all crops, particularly in sunflower and garlic due to either fluctuating prices for garlic or to the effects of the 1998/99 drought for sunflower. In fact, WP was lowest in all crops in that year as seasonal irrigation depths were much higher than in the other three years.

The combination of the ratio of measured irrigation supply to the simulated optimum demand and other performance indicators allowed for determining performance levels and improvement measures (Fig. 5). It was found that if additional water would be available for irrigation in the Genil-Cabra irrigation scheme, garlic and olive would be the crops that would profit the most from additional supplies. However, it was concluded that given the wide range in water use and management encountered at the individual plot level, improvement policies at the scheme level should always consider individual performance when designing measures for water conservation.

[9] This section is an extract from Lorite et al. (2004ab)

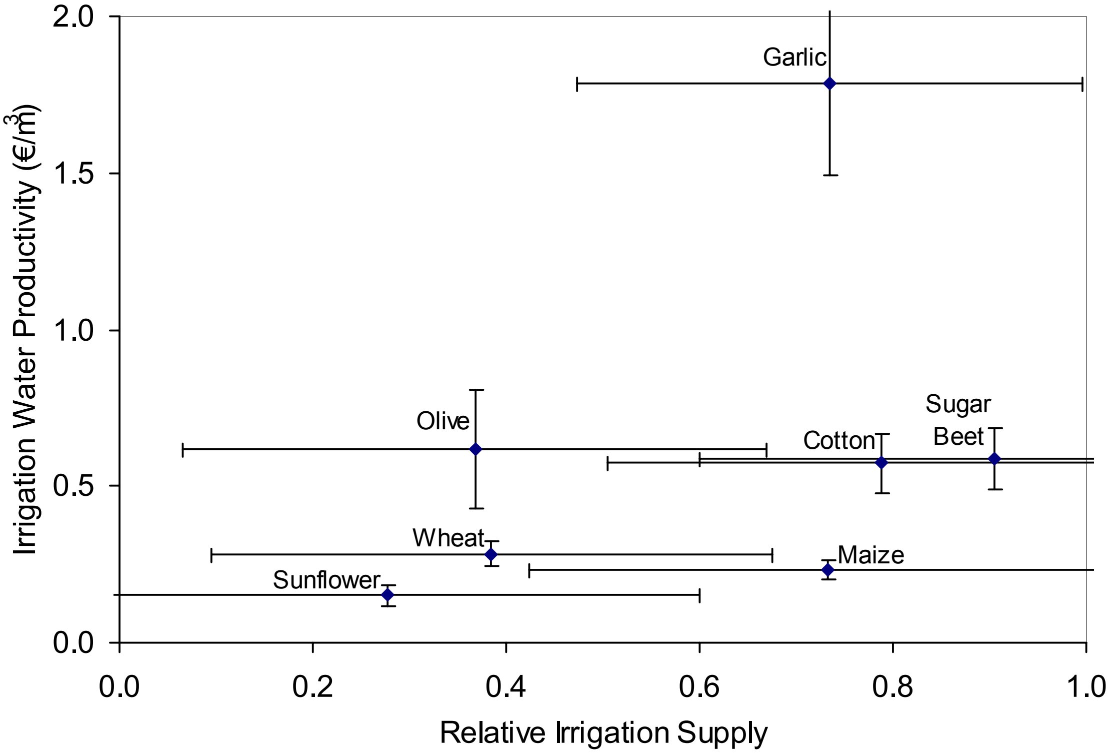

Fig. 5. Relation between irrigation water productivity and relative irrigation supply in the Genil–Cabra irrigation scheme. Values are averages for four irrigation seasons and the bars depict twice the standard deviation. Modified from Lorite el al. (2004b).

CONCLUSIONS

The organisational structure of the water users' associations in Spain has proven to be effective for the participatory management, operation and maintenance of the irrigation schemes. Thus, the new plans of modernisation have not required the reform of legal and institutional aspects, but they have focused mainly on the introduction of modern infrastructures and irrigation equipments. Pending issues are the rigorous control of the sustainability and the environmental effects of the irrigation practices, and the technical water management both at the farm and scheme levels.

The research work at the Institute for Sustainable Agriculture and the University of Córdoba have demonstrated that irrigation management and performance assessment tools may contribute to a more effective use of the irrigation water. The performance indicators calculated with SIMIS for the 2001-2002 irrigation campaign in the BXII irrigation scheme, when calculated in following years, will trace the level of service and water management in the scheme. The in-depth analysis of the Genil-Cabra irrigation scheme showed that the high variation in farm-to-farm and crop-to-crop water management implies that water conservation improvement policies at the scheme level should always consider individual performance.

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