Evaluating the potential impact of institutional reforms in the irrigation sector

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Abstract:

With increasing water scarcity, research on institutional policy options for improved water allocation and governance becomes an urgent priority for many developing and developed countries. This is certainly the case for the irrigation sector as large water user. Evaluating institutional alternatives, such as water rights systems, is however a challenging task. This article takes a comparative approach and compares case study data from Tunisia, South Africa and India demonstrating the importance of the water rights system for irrigators. Using contingent valuation methods, hypothetical changes in water rights systems are evaluated. In the three countries, willingness to pay estimates reveal that from the farmers' perspective significant improvements can be made to the existing water rights systems. Case studies like these can yield valuable information for policy makers to guide institutional reforms.

Keywords: Property rights, India, Tunisia, South Africa

1. INTRODUCTION

Increasing population growth, economic activity and development pose increasing stress on the world's finite water resources. In the past solutions were often sought in technical interventions, such as improved irrigation and water supply technology or interbasin transfers to increase supply in water-scarce regions. Now however, it is clear that water resources management requires an interdisciplinary approach and that sound institutional arrangements are crucial to improve water use efficiency and allocation (Kemper 2001; Brennan, 2002; Bruns et al., 2005). An institutional option receiving a lot of attention is the improvement of the water rights system (Araral, 2010; Gastélum et al. 2009; Molle, 2004; Bruns et al., 2005; Matthews, 2004; Meinzen-Dick & Nkonya, 2005; Hodgson, 2006) Kemper (2001) even emphasizes this as the most central point in institutional reform to achieve more efficient water use and allocative efficiency.

The theoretical rationale for installing water rights is based on arguments of efficiency, i.e., only when water rights are clearly defined Pareto optimal outcomes are possible (Araral, 2010). A clear definition of who is entitled to use a certain amount of water, with the specification on when and where this is possible, will reduce uncertainty and conflicts (Molle, 2004). In contrast, when property rights are poorly defined, this creates high transaction costs (information search, negotiation, monitoring) and limits the value people assign to a resource (Randall, 1978; Ostrom, 2000; Challen 2000, 2002, Wichelns 2004, Heltberg, 2002; Linde-Rahr, 2008). This confines the incentives for resource users to manage a resource sustainably (Yandle, 2007).

While empirical work related to property rights theory focuses mainly on explaining the role and functioning of property rights over natural resources, and in part on their emergence, more research is needed to quantify the degree of efficiency of a prevailing institutional structure or the benefits of improving it (Brennan, 2002; Dinar & Saleth, 2005; Linde-Rahr, 2008; Irimie & Essmann, 2009; Araral, 2010). This paper compares case study data from Tunisia, South Africa and India, highlighting the importance of the water rights system for irrigators. Following the suggestion by McCann *et al*. (2005) we use contingent valuation surveys to estimate willingness to pay to reduce policy related transaction costs as a measure of the degree of efficiency of the prevailing institutional structure in these three countries. Applications of using this approach were recently developed by several authors for the case of water rights (e.g., Crase et al., 2002; Herrera et al., 2004; Frija et al., 2008; Speelman et al., 2010a, 2010b; Veettil et al. 2011a, 2011b). The approach is also closely linked to the work of Barton & Bergland (2010) and Rigby et al. (2010), who use choice experiments to value irrigation water under different institutional settings.

The three case study areas are relevant to consider because they share some of the conditions identified by Bruns et al.,(2005) as favouring water rights reforms: (1) acute water shortages induced by increasing competition and conflict; (2) social inequities in the access to water; (3) severe water stress. There are however also important differences between the study areas: Tunisia and South Africa are clearly at different stages in the development of irrigation water rights. In Tunisia the irrigation water rights established during the French occupation were modified during the 1970s from a full individual property right towards a simple usage right for a given volume of water, generally in relation to the area of land owned (Al Atiri, 2007). In South Africa the shift to usage rights was only initiated by the 1999 Water Act. Furthermore, it has to be noted that while the Tunisian case study involves market-integrated small and medium size farms, the study in South Africa focuses on the small-scale irrigation sector, which is largely subsistence-oriented. It will thus be interesting to see if these differences have an effect on the valuation of irrigation water rights and on the importance farmers give to them. By contrast to Tunisia and South Africa, India had a variety of water rights systems of various kinds which were known to have existed in India for a long period of time under various kinds of community-based and state-managed irrigation systems (Narain, 2009). A latest reform of the Indian water policies and directives in the 1894 specifies that surface water is a public ownership and farmers have only the usage right of it. However, groundwater is attached to the land owner. Usually the land owners have the right over the ground water that flows under their land. This indistinct property right dimension attracted immediate attention from policy makers and they started formulating ground water bills to improve the existing inefficient right system. The Indian case study considered in this paper refers to highly crop-diversified small and medium size farms using common canals, lifts, tanks and tube wells for irrigation.

2. IMPORTANCE OF IRRIGATION WATER RIGHTS

Property rights can broadly be defined as the relationship among people regarding things. In this sense, water rights essentially represent a bundle of rights to a benefit stream, which can include rights to access, withdrawal, management, exclusion and transfer, and these rights are roughly cumulative (Schlager & Ostrom, 1992).

Clearly defined and secured water rights are important for several reasons. First, they determine if people are included or excluded in the control of a vital resource for their lives. Well-defined and secured water rights can also raise water productivity and can enhance rural livelihoods (Bruns et al., 2005). According to Coase (1960), well-defined property rights internalize the externalities, so that the outcome is efficient regardless of who owns the property rights (Gunchinmaa and Yakubov, 2010). Clearly defined and enforceable water rights are specifically important to developing countries faced with the challenges of better management of water resources. These challenges are likely to increase as a result of increasing urbanization, industrialization, environmental degradation, agricultural intensification and rising per capita water use. As demand for a limited resource increases, tensions and conflicts are likely to arise among various stakeholders in a river basin when water rights are unclear and insecure (Araral, 2010). A clear definition of who is entitled to use a certain amount of water, with the specification on when and where this is possible, will reduce uncertainty and conflicts (Molle, 2004). It will also increase efficiency because without a clear definition of who the users are and how much water they are entitled to, the users themselves have no incentive to use the water efficiently having no guarantee that if they save water today they will receive more tomorrow. (Kemper 2001). Furthermore by giving water users certainty as to what water will be available to them, both over the long term and in any given year provides them with confidence to plan for the future and to invest in water-dependent activities. It also reduces the potential for conflicts, as sharing arrangements are transparent and settled in advance, and provides incentives for more efficient use of resources (Speed, 2009). Finally it is stated by Bruns et al. (2005) that lack of well-defined and unsecure water rights mainly increases the vulnerability of the poor and of politically and economically marginalized water users.

In a New Institutional Economic perspective, the water rights are seen as an institution that serve as a source of incentives for individual or group behavior governing water use. These institutions stimulate efficient resource use and avoid depletion or overexploitation of water resources as well as averting the tragedy of commons. The water institutions and policies aiming at efficiënt water right systems are portrayed as a means of addressing 'incentive gap' (Saleth, 1996, 2005). Water use rights are thus essential to provide incentives for better water management, but contrary to common belief, there is ample scope to design them in a flexible and locally adapted manner to allow for local needs and circumstances, which may want to take into account individual or common property right cultures, different lengths of validity of the rights, and (non-)transferability (Kemper, 2001).

3. WATER RIGHTS SYSTEMS IN SOUTH AFRICA , TUNISIA, INDIA

3.1. South Africa

In South Africa, the National Water Act (Republic of South Africa, 1998) replaced the previous system of water rights and entitlements, which had been based on the ownership of riparian land, with a new system of administrative limited-period and conditional authorizations to use water (Nieuwoudt, 2002). This change was part of the efforts of the new democratic government to overcome the legacy of the apartheid system by restructuring the constitution, legal system, policies and administration (Wester et al., 2003). It has to be noted that this new system only concerns usufruct right, while ownership of the water is held by the state.

Although the new water rights system is currently still not fully operational, several authors have already identified shortcomings. Backeberg (2006) predicted that the short review period for licenses of five years will have a negative effect on farmers' investment decisions. This review period was installed to allow the government to take timely measures to maintain the integrity of the water resource, achieve a balance between available water and water requirements, or accommodate changes in water use priorities (DWAF, 2004). However, that conditions attached to licenses may change at each review (for instance the volumes and timing of abstractions, or the volume that may be stored etc.) gives farmers the impression that licences are insecure (Nieuwoudt & Armitage, 2004). The same authors furthermore point out that the reliability of allocation is impeded because there is no guaranteed supply; although quantities are specified in the license, they are not guaranteed or enforced (Republic of South Africa, 1998). Louw & Van Schalkwyk (2002) criticized the provisions regarding transferability made in the National Water Act. Transferable water rights and water markets are generally believed to improve water productivity through the transfer of water from low value users to high value users (Bjornlund & McKay, 2002; Nieuwoudt & Armitage, 2004; Bruns & Meinzen-Dick, 2005; Zekri & Easter, 2007; Brooks & Harris, 2008) but over-regulation of transfers reduces the efficiency gains (Rosegrant et al., 1995; Shi, 2006; Donohew, 2009). In South Africa, trade in water use authorizations is to be treated in a similar way as new license applications. This means that a water management agency has to approve each transfer. For transfers of water rights between irrigators in the same irrigation scheme, possible externalities of the transfer are limited (Donohew, 2009) and thus the type of administrative procedure proposed appears to create unnecessary transaction costs, limiting efficiency gains from water right transfers.

3.2 Tunisia

In the study of Tunisia, two main components of the water rights system are distinguished: the “water access right” and the “water delivery right”. The water access right mainly concerns the security of the water right and specifies the ownership, tenure and the quantification of the right. It also includes the legal definitions in relation to the abstraction or use of water. In contrast, the water delivery right is defined as the right to have water delivered via an infrastructure operator. This component therefore relates more to water supply reliability and to WUA performance, WUAs being the active infrastructure operators in Tunisia.

The water access right changed in the mid 1970s from a full property right to a simple usage right for a certain volume of water linked to land ownership (Al Atiri, 2007). This institutional change happened during a period of fundamental institutional reforms in the Tunisian water sector. The objective of this first reform was to give public authorities decision powers over water resources and over water allocation between users. After a period of central water resource management, a second shift occurred moving towards decentralized allocation by WUAs. It is clear from the above that in contrast to the South African case, in Tunisia the process of property right change started earlier than the decentralization process.

Based on a review of empirical studies concerning the irrigation water sector in Tunisia (Chraga & Chemakh, 2003; Ben Salem et al, 2005; Makkaoui, 2006; Chebil et al, 2007, Frija, 2009), we found that the instability of irrigation water supply (due to water scarcity and technical problems in the irrigation network) is an important factor affecting the perception and behavior of farmers. In addition, in most cases farmers are ignorant about the total quantity of water allocated to them at the beginning of an agricultural season. Furthermore, the water access right is not transferable between farmers, or between farmers and the WUA. Irrigators have to use their rights themselves, or lose them. Given the water shortages being faced by the country, the possible benefits of a more flexible transferable quota system was investigated.

With regard to the water delivery right, several authors (Frija, 2009; Makkaoui, 2006; Ben Salem *et al*., 2005; Chraga & Chemakh, 2003) show that technical and organizational problems still occur in Tunisia and that these affect the perceptions of the irrigators. We therefore believe that an improved reliability of supply will have an effect on irrigation water use efficiency.

3.3. India

In India, the Easement Act of 1882 made all rivers and lakes the absolute right of the state. Individual rights to both surface water and groundwater are recognized only indirectly through land rights. Thanks to the ‘dominant heritage’ principle implied in the Transfer of Property Act IV of 1882 and the Land Acquisition Act of 1894, a land owner can have a right to groundwater as it is considered an easement connected to the land (Saleth, 2004). In the case of canal water, the rights to access are limited only to those having access to land in canal command areas and these rights are only use rights and not ownership rights. In fact, the irrigation acts in all states in India, do not allow the moving of canal water to non canal areas. Thus the water governance and utility services are highly influenced by the public government institutions and in most cases the irrigation services are very poor. But efforts were made to decentralise the water governance to local level by introducing Water User Associations, but at many times the transfer of water rights did not take place. The failure of water rights transfer or creation (including legally binding water rights), often lead to poor performance of WUAs and irrigation water services.

Similarly to the Tunisian and South African cases, three water right dimensions were chosen to be studied for the case of India: duration of the right, supply reliability and transferability of the right. With water rights of long duration, farmers are more likely to invest in irrigation and water saving technologies at farm or WUA levels (Davis, 2007; Hodgson, 2006). The *supply reliability* characteristic of the water right describes the timeliness and dependability of water supply. *Transferability* of the water right enables the farmer to transfer the individual entitlement to others, either temporarily or permanently, according to specified rules. If such transfers can be made for a proportion of the entitlement, the water right is called divisible. The three water right dimensions above determine whether the rights are well or poorly defined: In terms of transferability, for example, a situation where water rights are not transferable reflects poorly defined rights, whilst in a situation where water rights are transferable, the rights are considered to be properly defined. By the same, long duration and reliable water rights are considered as clearly defined rights (this definition is in line with attenuation of water rights as suggested by Crase and Dollery, 2006, and Molle, 2004). For the Indian case study, the impact of water property rights definition on farmers’ preferences and willingness to pay for different pricing methods will be stressed.

4. METHODOLOGY

4.1 Data collection

The South African data were collected in April 2008 in the Limpopo province of South Africa. A sample of typical South African smallholder irrigation schemes was established. Both larger irrigation schemes with over 100 farmers and smaller schemes, with only 30–40 farmers, were included in the sample. Furthermore, it was also ensured that differences in cropping patterns reflecting varying degrees of water scarcity were covered. In total, seven irrigation schemes were identified from the national database of small-scale irrigation schemes. Within the schemes, about 30% of farmers were randomly selected from a list of active farmers. Structured questionnaires were used capturing detailed information regarding farming activities, alternative income sources and other relevant institutional aspects of water management as well as a contingent ranking experiment on irrigation water rights. In total, 134 questionnaires were completed, which provided 402 choice sets for analysis.

In Tunisia data was collected in the Cap Bon region in the North Eastern part of the country. This region is one of the important areas for irrigated agriculture in Tunisia. The dataset used in this paper was collected in 2007 from farmers of the Fondok Jedid (FJ) and Lebna Barrage (LB) areas. The dataset included 18.7% (30 farmers) and 30% (32 farmers) of the farmers of the FJ and LB WUA, respectively. The questionnaire used in the LB and FJ irrigated areas consisted of the following parts: (i) farmer identification (socio–economic and demographic characteristics); (ii) farm identification (cultivated crops, quantities and costs of inputs; quantities and values of outputs, etc.); (iii) identification of water use, source and quality; (iv) evaluation of farmers' attitudes and perceptions concerning local irrigation water governance (functioning of their WUA); and, finally, the contingent valuation experiment.

In India, data were collected from farmers in the Krishna river basin area of northern Karnataka state between January and March 2008, using face-to-face interviews. The study area includes four sub-basins, namely Lower Krishna, Ghataprabha, Malaprabha and Tungabhadra. In two steps the villages, and farmers within the villages, were randomly selected. First a list of villages was collected from the district headquarters and arranged in alphabetical order. Randomly 8, 6, 6 and 12 villages were collected respectively from the Lower Krishna, Ghataprabha, Malaprabha and Tungabhadra sub-basins. Then the farmers were randomly selected from each village. A pilot study, involving 30 farmers from non-selected villages, was undertaken to check the validity of the experimental design. Some necessary changes were made before conducting the actual choice experiment. From the selected villages, 320 farmers were interviewed in their homes. 30 farmers did not fully complete the interview and were hence discarded from the analysis. During the face-to-face interviews with farmers, detailed information was provided to them on each water pricing method, as well as on the attributes of the water rights and their levels (see Veettil et al 2011a and 2011b for more details).

4.2 Analysis

As mentioned in the previous section, to analyze the water rights system in South Africa and in India, choice experiments were developed (Speelman et al., 2010a; Veettil et al., 2011). The technique, which originates from marketing and transportation science, has proven to be useful in valuing multi-dimensional interventions in a system (Hanley et al., 2001, Bateman et al., 2006; Burton et al., 2007; Rigby et al., 2010). The technique enables both entire interventions and their individual components to be valued. In this way, willingness to pay for improvements in the water rights system can be determined. An advantage of choice experiments is that they avoids an explicit elicitation of the respondents' willingness to pay but rely instead on the ranking of (South African Study) or choice from (Indian Study) a series of alternative packages of characteristics. This has proven to be a more reliable way of eliciting willingness-to-pay values (Foster & Mourato, 2002; Bateman et al., 2006).

For the South African case three characteristics of property rights were selected based on a literature review (Louw & van Schalkwyk, 2002; Nieuwoudt, 2002; Perret, 2002; Nieuwoudt & Armitage, 2004; Backeberg, 2006; Pott et al., 2009) and expert knowledge. The focus was thus not on operational-level rights but instead on so called "property rights dimensions". According to Yandle (2007), these dimensions can be used to assess the quality of the property right. The dimensions examined for South Africa were duration, transferability and quality of title. Duration refers to the period of time for which the operational-level rights are guaranteed, or the time until the rights regime is renegotiated. This aspect is important because for rights holders to have the incentive to use a resource sustainably, they must be confident in the time period over which their rights to the resource will not be diminished (Backeberg, 2006; Yandle, 2007). Transferability considers if transfers of water rights are allowed and which procedures are used for transfers. Finally, the quality of the title dimension describes the capacity of the title to adequately define the resource and how much of a resource rights holders may extract.

Specification of the attributes space of a choice experiment also comprises the stipulation of the attribute levels used in the experiment. In South Africa for duration, two levels (5 years and 10 years) were included. For transferability the levels considered were no transfer; agency based transfer and market transfer, and for quality of the title, two levels were used in this study: no guaranteed supply and guaranteed supply. An example of a choice card used in the South African choice experiment is provided in Fig 1. The econometric analysis of the data collected in South Africa is based on the rank-ordered logit model (Beggs et al. 1981), which as an extension of the basic conditional logit model of McFadden (1974) is grounded in random utility.

For a detailed description of the experiment and the econometric model, see Speelman et al. (2010b) and Veettil et al (2011 a, 2011b).

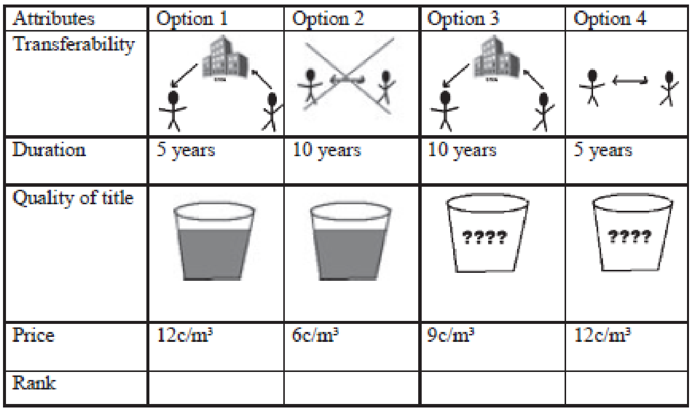

Fig 1. Choice Set Example used for the South African case study

Regarding the Indian case study, few scenarios were built-up with regard to water right dimensions (duration, transferability and reliability of right) and water pricing methods. The *duration* of water rights denotes the length of the water entitlement. Two levels of duration have been selected for the present study: short and long duration. Under short duration, water rights are limited to one or only a few crop seasons (< 2 years), whereas in long duration, the water entitlement is for more crop seasons (up to 5-10 years). Concerning the *supply reliability*, a guaranteed supply ensures the irrigation water supply as prescribed in the water contract, whereas under non-guaranteed supply there is no standard supply schedule. T*ransferability* scenarios were divided into four levels of water right transfers which are: No transfers, transfers within WUA, transfers between WUAs and transfers via a water market. Farmers are not allowed to transfer their water entitlement under the "no transfer" scenario whereas this is permitted in all other scenarios, but potentially restricted to transfers within or between WUAs. In the second scenario water can be transferred between farmers within the same WUA but not between farmers from different WUAs. Under the third scenario farmers are not directly involved in transfers of water rights, because the rights are transferred by the WUA. Under the water market scenario, both farmers and WUAs can trade water right entitlements at a water market. This transferability of water rights in water markets will result in a near water market situation for water pricing. The three water right dimensions above determine whether the rights are well or poorly defined. An example of choice set used in the Indian choice experiment is presented in table 1.

Table 1. An example choice set

If options crop price, quota price, volumetric price, area price were only available, which one would you chose?

Characteristics	CP	BP	VP	AP (status quo)
Duration	Long	Short	short	Short
Supply	Not-guaranteed	Guaranteed	Guaranteed	Not-guaranteed
Water transaction	Within WUA	No-Transfer	Between WUA	No-Transfer
Payment	450 Rs	2100 Rs	30Rs/acre-inch	150 Rs
I choose	☐	☐	☐	☐

In the Tunisian case study, as for South Africa and India, it is again assumed that the opportunity for water rights system enhancements can be evaluated by non-market methods and that it can be assessed by estimating and aggregating individual preferences. However, the design of the experiment is different since we used the contingent valuation method. A single bounded dichotomous choice format is used to assess farmers' WTP for hypothetical possible improvements in water right attributes. Three scenarios were identified (Table 2), making assumptions concerning the water access right and the water delivery right.

For the water delivery right, improvements in water supply reliability were assessed, while in terms of the access right the introduction of quotas and transferability was analysed. Supply reliability could, for example, be enhanced through improvements in WUA efficiency and functioning. The supply reliability scenario, in which a more reliable water supply was proposed to the farmers, is relevant because most farmers are worried about irregularities in water delivery, especially at times when they need water urgently. The second scenario (clarity scenario) explicitly quantifies the water access right by defining quotas. This explicit quantification ensures better security of farmers' current water entitlements. By introducing a clearly quantified quota, farmers know the quantity of water available to them during the coming irrigation season in advance (Hodgson, 2006). Finally, the third scenario relates to the transferability of the water access right. However, since transferability requires that the right is quantified (Matthews, 2004; Bjornlund, 2006; Mollinga et al., 2007), the third scenario was constructed by adding a transferability option to the second scenario. This scenario is therefore called the "clarity + transferability" scenario. For each scenario, different price bids were proposed to the farmers, who had to accept or reject them. For a detailed description of the experiment, see Frija *et al.,* (2008).

Table 2 Property rights and attributes used for building CV scenarios

Water right components	Attribute of the component	Name of the scenario
"Water access right"	- "security of the entitlement": quantification	- "clarity scenario"
	- "transferability of the entitlement": market	- "clarity + transferability"
"Water delivery right"	- "supply reliability"	- "allocation reliability"

5. RESULTS

5.1. South African case study

For the South African case study, the rank ordered logit estimates are presented in table 3 below. All the coefficients are significantly different from zero at the 5% significance level, meaning that they all are significant determinants of farmers' choice. The signs of the attribute parameters are as expected. Guarantee of water supply, increased duration of the license and improvements in transferability all increased the probability that an option was chosen. Oppositely, a higher water price decreased the choice probability.

Table 3 also presents the estimates of the implicit prices for individual attribute changes. These results indicate that the opportunity to transfer water licenses is highly valued. However, the move from a system of administrative transfer to water markets does not seem to add much value. High importance is furthermore attached to guaranteed water supply. Finally the results suggest that increasing the review period of the licenses from 5 to 10 years is an interesting intervention, since apart from the economic gain perceived by the farmers, which are reported in table 3, this would certainly decrease administrative costs

Table 3 Rank ordered logit results: determinants of ranking

Attribute	**coefficient**	**SE**	**p-value**
Duration	0.0957	0.0136	0.000
Quality of title	0.6284	0.0382	0.000
Price	-0.0478	0.0147	0.001
Agency based transfer	0.2300	0.0496	0.000
Market transfer	0.3598	0.0514	0.000
<u>*Model statistics*</u>			
LogL(initial)	-1277.58		
LogL(final)	-1051.47		
Pseudo R^2	0.177		
Attribute change	**Implicit WTP**		
No transfer to agency based transfer	14.6 c/m³		
Agency based transfer to market transfer	2.4 c/m³		
No secured supply to secured supply	12.6 c/m³		
5 years to 10 years	9.7 c/m³		

5.2. Indian case study

As for the Indian case the conception of the study is a bid different from the South African and Tunisian case, results from multinomial Probit model estimation provided WTP for complementary relation between water rights attributes level, pricing methods, and quality of local governance (existence or not of a local WUA). This is also interesting since it reflects not only the farmers' preferences towards different water rights dimensions, but also how this preference is affected under other water management tools and conditions. Results for marginal WTP estimates for complementary relations are presented in table 4 below.

Table 4 Marginal WTP estimates for complementary relations

Water pricing [a]	Local water Governance [a]	Water rights [a]	WTP (€/ acre-inch)
Crop pricing	Absent	Poorly defined	-0.24
Crop pricing	Present	Poorly defined	-0.34
Crop pricing	Absent	Well defined	-0.01
Crop pricing	Present	Well defined	-0.10
Quota pricing	Absent	Poorly defined	0.38
Quota pricing	Present	Poorly defined	-0.13
Quota pricing	Absent	Well defined	0.62
Quota pricing	Present	Well defined	0.10
Volumetric pricing	Absent	Poorly defined	0.05
Volumetric pricing	Present	Poorly defined	-0.26
Volumetric pricing	Absent	Well defined	0.29
Volumetric pricing	Present	Well defined	-0.03

([a] Base level: *Area* pricing with the *absence* of local water governance and *poorly* defined water rights)

Table 4 shows that willingness to pay of farmers for different scenarios of water pricing and local water governance always increases when the water rights are well defined. For example, farmers WTP for BP method in absence of WUA changed from 0.38 to 0.62 €./acre-inch by simply well defining the farmers property right (longer duration, transferability, and reliability of right). Moreover, farmers WTP for VP method in absence of WUA changed from 0.05 to 0.29 €/acre-inch by only having a better definition (suitable for farmers) of water rights. This shows that a clear and good definition of property rights may be considered as motivating factors for farmers to pay for water, which will be inline with the cost recovery objective of most of policy makers in India.

5.3. Tunisian case study

The dichotomous choice model build for the Tunisian case study was estimated using the collected data. Coefficients of the estimated Hanemann models (Hanemann, 1984) are shown in table 5. Table 5 also reported the calculated mean willingness to pay for each property right scenario using the coefficients of the constant and of the bid price variable.

Table 5. Estimation of the Hanemann model with only the bid price as independent variable

Dependent Variable: Willingness to pay (binary choice)					
		Constant		Bid price	
Models (scenarios)		**Coefficient**	**P-Value**	**Coefficient**	**P-Value**
Allocation reliability model (1)		0.7677	0.305	-53.66	0.004***
Clarity model (2)		0.3426	0.648	-50.4143	0.012**
Clarity + transferability model (3)		1.6661	0.011**	-45.7663	0.000***
Models Statistics					
Log-likelihood (model1)	-25.80				
LR (model1)	11.37***				
Log-likelihood (model2)	-23.40				
LR (model2)	9.66***				
Log-likelihood (model3)	-34.39				
LR (model3)	17.40***				
Scenarios	**Implicit WTP (TND)**				
Scenario1	0.0143				
Scenario2	0.0068				
Scenario3	0.0364				

*, **, *** = significant at 10%, 5%, and 1% level respectively.

Farmers were found to be willing to pay for all the tested institutional scenarios. However, the value of this WTP is different from one scenario to another. Table 5 shows that the WTP for an improvement of the reliability of irrigation water provision in the study area is about 0.0143 TND/m3; which corresponds to respectively 29.7% and 21% of current water prices charged to farmers in FJ and LB. This suggests that water delivery reliability is an actual problem that affects farmers in the studied areas.

Quantification of the water access rights at the beginning of the irrigation season does not appear to be a priority for farmers. The recorded WTP for this scenario was positive but very low (0.0068 TND/m3). Under this scenario the new aggregated irrigation water prices would become 14.1% and 10% higher than the current price charged to farmers. Adding the transferability option to the second scenario increases farmers' WTP substantially. WTP for the third scenario was around 0.0372 TND/m3 which is 77.5% of the current price in FJ and 54.7% of current prices charged in the LB area. Transferable quotas would then considerably increase the utility of the farmers.

6. DISCUSSIONS

A common result from all case studies in this paper is that farmers are always willing to pay for water when water rights are better defined, if they believe that such improvements decrease their transaction costs or increase the efficiency of the production system (thus decreasing the cost). However, for some specific cases, farmers may prefer some particular features of the water rights to others, such for the transferability option. This result reveals that from a farmers' perspective significant improvements can be made to the current water rights systems in South Africa, India and Tunisia. While decentralization and water management transfer is still an ongoing process in South Africa, the case study in Tunisia and India already showed that farmers' opinion concerning the local water governance (mainly concerning the WUA organisational and technical performances) strongly affects their WTP (Frija, 2009; Veettil, 2011). This implies that it is important for the governments in developing countries to enhance performance of local water management institutions and to increase the trust of farmers in these institutions, since this will increase their WTP for the proposed interventions in the water rights. According to the latter authors, water property rights reforms should not then be considered as separate action with expected outcome, but as a tool among a whole reform package including effective pricing methods, better local governance of water, and technical modernisation of the irrigated areas. This statement is clearly proved in this work through the Indian case study which focus on the effect of different water rights attributes on the farmers' preferences for different water pricing methods. Abernethy (2005), on the other hand, suggested the need to build political support for water law reforms, developing a hierarchy for basin organizations, integrating existing rights and users, measuring water usage, controlling water quality, enforcing compliance, financing basin water management, and creating incentives for transfers between uses. Kemper (2001) consider that a starting point to consider by policy makers is that all actors are responsive to incentives. These incentives are provided by the institutional arrangements around them which mainly include (i) the water (use) right, (ii) the price of water, (iii) the existence of law mandating a certain way to use water (e.g., recycling, or the maintenance of environmental stream flows in river beds), (iv) the enforcement of such laws and regulations (monitoring) through a sanctioning system (e.g., fines, peer pressure) and (v) the access to information about all of the above.

Among the water right attributes considered in this study, quantification of the title and supply reliability of the water delivery right was shown to be highly important in the studied cases. Some authors argue that the key factor for the adoption of water saving in irrigation is the availability of a dependable and timely water supply (Mushtaq et al., 2009). Lack of reliable water sources or uncertainty in water supply can play a major role in water management and the subsequent adoption of water-saving measures (Mushtaq et al., 2009). Moreover, Kemper (2001) states that without a clear definition of who the users are and how much water they are entitled to, the users themselves have no incentive to use the water efficiently because they have no guarantee that if they save water today they will receive more tomorrow. Both case studies in Tunisia and South Africa included an assessment of the importance that farmers attach to knowing how much water they will receive. Previous studies in the South of Spain by Alcon et al. (2008) and Rigby et al. (2010) suggest that generally farmers highly value certainty of supply. While in South Africa this appears to be the case and high importance is attached to guaranteed water supply, in Tunisia the clarity model hardly increased WTP for water. However, the relatively high WTP for the supply reliability scenario, which suggests that reliability of supply is a real problem in Tunisia, could explain this. Clearly the importance of knowing the size of one's water allocation is reduced if that person is uncertain to get the right amount of water at the time when he needs it. Furthermore about half of the farmers in the Tunisian case study owns a well and therefore they also have access to groundwater. This probably reduces the average WTP both for the stability and clarity scenario because conjunctive use of surface and groundwater can ensure guaranteed supply and increase reliability. This role of groundwater was also reported by Marquez et al. (2005).

Transferability of water property right was also found to be of high interest for farmers in this study. Making the water rights transferable has a large positive effect on farmers' WTP for irrigation water in Tunisia and South Africa. Theoretically, making water entitlements transferable would also allow the reallocation of rights on the basis of economic efficiency, while providing a compensation mechanism (Molle et al., 2004). This is in line with neoclassical economics, which see property rights as a fundamental concept of development, or even as the core of capitalism (De Soto, 2000; Demetz, 1973, in Molle et al., 2004). Many other studies proves that the introduction of water markets in Tunisia, India, and South Africa are beneficial for efficient allocation of water resources (Bachta et al., 2004; Hamdane, 2002; Nieuwoudt & Armitage, 2004; Manjunatha et al., 2009). However, in addition to clearly defined and transferable water rights, water markets also require physical infrastructure that will allow water to be transferred from one user to another, and institutional arrangements to protect against negative impacts on third parties when water is transferred; which are rarely found in developing countries (Easter et al., 1998). While our case studies focus on farmers' preferences clearly the introduction and the nature of tradable water rights also has an impact on the transaction costs beard by government (Mc Cann et al., 2005). These costs should also be taken into account when deciding upon the desirability of introducing markets. Hamdane (2002) suggests that in Tunisia introducing a water market would require fundamental and costly institutional reforms. In South Africa, where administrative transfers are foreseen to be introduced following the National Water Act (1998), Louw and van Schalkwyk (2002) plead for water markets because they claim that the excessive transaction costs related to an administrative approach will erode the advantages of trade. Thus, although farmers' WTP to go from administrative transfers to water markets is relatively small in our case study, it should be investigated to which extent water markets can decrease the administrative burden and associated costs of the agency based transfer system.

7. CONCLUSIONS

In the current context of increasing water scarcity in many developing and developed countries, institutional options and tools for improved water allocation and governance becomes an urgent research priority. However, evaluating institutional alternatives, such as water rights systems, is a real challenging task. From methodological point of view, the current work shows that non-market valuation methods could be of high interest to overcome this challenge. Choice experiment and contingent valuation approaches were successfully used to asses the farmers WTP for hypothetical property rights scenarios assuming improvement of the water rights definitions. The methods results were consistent and provide interesting information about farmers' preferences for different dimensions of the water rights in the three considered countries: Tunisia, India, and South Africa. The WTP estimates for changes in the water rights system measured by these techniques are a reflection of the differences in transaction costs. Overall, the estimation of WTP indicates that significant inefficiencies exist in the current water right system in the considered countries. Tackling these inefficiencies will not only be favourable for the efficiency of water use of smallholder irrigators, but given the size of the benefits, could also add significantly to the government objective of cost recovery, which is a hot issue in many developing countries. With a higher WTP for water there is also more scope for government to increase water prices for irrigators and to reach high cost recovery rates.

Finally, it should be mentioned that the results drawn in this study should be considered as a part of a broader framework. In addition to the transaction costs borne by farmers (on which we assume they base their choice and preferences for different property rights systems), there is also another type of transaction costs corresponding mainly to the public costs of implementation and maintenance of the different institutional alternatives, in addition to the costs of institutional change itself (Challen, 2002; McCann & Easter, 2004). These costs should be considered by policy maker when examining different institutional options for agricultural water management.

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