Potential for water use right market development in Italy: social acceptability in the context of climate change

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Summary

Water scarcity and droughts events in Italy are occurring more frequently than in previous decades and are forecasted to be more severe in the future. Current water management will likely be no more suitable to face extreme events and more efficient instruments to balance future demand and supply of water resources, like water markets, are needed. The paper provides a description of the water scarcity and droughts issues as they are determined by climate change along with related weather patterns predictions for the next decades in Italy. Potential policy options that could be suitable for mitigating the effects of future weather patterns on the Italian agricultural sector are presented and critically commented. Social acceptability of economic and policy instruments, envisaged for tackling the issues of water scarcity and droughts, is explored by a twofold perspective: i) analyzing the argument by referring to recent scientific findings and ii) examining empirically the elicited social sensitiveness to both the phenomena and the instruments as regard the Italian context. The results show a prevailing awareness of the interviewees with regard the climate change phenomena and a common consensus about the need of improving the efficiency in water management. Surprisingly, a positive attitude toward the engagement in water exchange mechanisms emerged along with a preference for farm-to-farm and agriculture-domestic water exchanges. Normative and ethical inertias represents the major obstacle for the social acceptability and development of water markets. Information plays a major role in reducing biases in social perception of the water scarcity and droughts phenomena and related contrasting measures. Research is needed to address the interactions between social acceptability, economic viability and implementability of the proposed instruments.

Keywords: climate change, water scarcity and droughts, economic and policy instruments, social sensitiveness, social acceptability
JEL Classification codes: Q25, Q28, Q54, A13

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1. INTRODUCTION

The agricultural sector in Southern Europe is facing new challenges created by changes in climate conditions. Extreme weather events, like droughts and water scarcity, are occurring more frequently than before, generating uncertainties that negatively affect agricultural production and related farmers' income. Irrigated agriculture is bearing the highest burden of those uncertainties since the production decisions are made far in advance with respect to summer seasons and because production outcomes depend highly on the timely availability of irrigation water.

Water shortages and drought events have repeatedly hit Italian agriculture in the last decade, especially in the Northern areas which are traditionally considered water abundant territories, and forecasts of climate models highlight potential increases in the near future of the conditions originating such extreme events (IPCC, 2007; Tomozeiu et al, 2011).

The Italian agricultural sector, hence, is in need of measures able to guarantee a sufficient provision of irrigation water and to mitigate the effects of unfavourable weather conditions on farmers' income variability. Such measures ought to be designed, targeted and implemented in accordance to the specificities of the agricultural activities and of the territories in which farms are operated. However, interventions related to water resources management in Italy, beyond satisfying the requirements/conditions of efficiency and equity like any other measure, are subject to strong social judgments and acceptance due to the trans-sectorial characteristic of water needs, their hierarchy of uses provided by the regulation and, most important, the status of publicly owned good, all of which have had a remarkable role in moulding the juridical and institutional settings as well. Social sensitivity with respect to water management issues has a strong weight in constraining the range of actions availabale to policy decision making and, hence, it is a factor to take in extreme regard when considering the proposal and feasibility of specific measures, especially with respect to the potential introduction of institutional forms that have no legal basis at the moment in Italy, such as irrigation water exchange mechanism, or at most irrigation water markets.

The objective of the paper is to explore the social acceptability of economic and policy instruments envisaged for tackling the issues of water scarcity and droughts by a twofold perspective: i) analysing the argument by referring to recent scientific findings and ii) examining empirically social sensitiveness to both the phenomena and the instruments as regards the Italian context. The paper has an explorative aim as regard the relations between climate change phenomena and social acceptability and represents a potential base for developing further investigations based on quantitative methods.

In the next section, we outline the issues of droughts and water scarcity related to climate change projections, followed, in the third section, by an overview of the potential instruments to be introduced, focusing on the juridical and institutional constraints. The fourth section presents the results of interviews submitted to stakeholders with the intent of exploring their sensitivity to the water-related issues induced by climate change and of eliciting their opinions about the implementation of specific measures, including the introduction of water markets. The last section closes the paper with a discussion and concluding remarks.

2. FUTURE AND CURRENT IMPACTS OF CLIMATE CHANGE

According to the Intergovernmental Panel on Climate Change (IPCC) (2007), climate change scenarios for the next decades (2020-2050) assure for European territories increases between 1 and 2°C in the average level of temperatures with respect to the levels recorded in the period 1960-1990. Less confidence is reserved, instead, for changes in precipitations, which will not record significant variations in average cumulative rainfall levels, but rather will enlarge its variability and concentrate rainy periods in autumn and spring and dry periods in winter and summer.

Based on the IPCC scenarios, Tomozeiu et al (2011) operated a downscaling of the climate forecasts for Italy, confirming on a general level the findings of IPCC and highlighting some peculiarities. All over the Italian territories, a raise of 1,5°C in average levels of temperatures is foreseen in all seasons with no remarkable changes in their distributions, except for maximum temperatures for which increases in variability predict a higher frequency of extreme levels. Future precipitation patterns are more heterogeneous, showing differentiated changes on the Italian territory. Precipitations in Northern Italy (mainly Po River Basin area) are forecasted to increase in spring and autumn (about +20%) and decrease in summer (about -25%), with a slight reduction in cumulative rainfall. For Southern Regions, instead, a general decrease in cumulative rainfall is predicted. In particular, the models report a reduction of about 20% of precipitations in spring, higher reduction in summer precipitations with respect to Northern areas (up to about -40%) and decreases in autumn.

The consequences of climate change predictions will translate in the enlargement of the irrigation season, increases in water needs of crops and reductions in water availability. In summer seasons, water stress could be more severe with joint occurrences of rain deficits and extreme levels of maximum temperatures, implying increments in evapotranspiration. The agronomic characteristics of the territories will likely be altered, making necessary the transition from rainfed to irrigated agriculture and the increase of irrigation water availability to keep farms economically viable. In the context of such changes, farmers will be exposed to extreme weather risks and will face higher uncertainties in both crops' management and production outcomes.

In the last decade, several occurrences of climatic anomalies have been recorded over the Italian territories during the summer season, but in 2003, 2006, 2007 and 2012 the status of natural calamities for drought have been declared for most of the Italian regions. In particular, for years 2006 and 2007 anomalies in precipitation derive from a declining trend started in 2004 and, similarly, anomalies in maximum temperatures followed an increasing trend from 2005. The drought occurred in 2003, instead, is an isolated event with respects the contiguous years and the recorded anomalies in both maximum temperatures and cumulative precipitations favoured repeated heat waves phenomena (ISTAT, 2010). The last drought event of 2012 presented the same occurrences of anomalies recorded in 2003 (isolated event), but, given the absence of weather data elaboration, a precise description cannot be provided.

In all these drought years, the main cause of the decrease in agricultural production can be partially attributed to the reduced availability of irrigation water and also to other complementary factors, like normative framework and water pricing mechanisms, that, with adequate instruments, could support the improvement of water resources management . Indeed, in summer seasons, the demand from domestic, tourist and agricultural sectors, as well as the natural environment, rears up and consume available water resources mainly stored during previous seasons (glaciers, dams, water tables). When critical levels of water availability are reached, water is rationed and destined to prior needs, like domestic and tourist, leaving agriculture exposed to weather uncertainties and letting farmers to face drought risks by adopting different and drastic actions which, most of the times, have the effects of reducing revenues (letting alone contributing to environmental and water ecosystems degradation), like extracting groundwater from deeper water tables' levels (increasing production costs) or forgoing to harvest a crop (minimizing income losses).

Therefore, in order to mitigate the negative effects of droughts and water scarcity on crop productions and related revenues, farmers will need access to and a secure provision of irrigation water along with economic instruments able to guarantee the efficient allocation of water resources and to prevent the resort to ex-post interventions (indemnities) in cases of natural calamities, i.e. droughts.

3. POLICY OPTIONS

3.1. Water policy background

Current and future climate scenarios call for the adoption of adaptation measures, to implement in the short-run, oriented toward the lining up of water availability and water uses. Given the cyclical nature of water resources, policy options ought to address water management issues such to increase the future availability and to improve the efficiency of water allocations in a harmonized intervention framework.

By adopting the Water Framework Directive (WFD) 2000/60/CE, the European Union (EU) started the process of policy interventions for the safeguard of water resources with a first important step oriented to the reduction of pollutant charges in the water bodies. Improvements in water quality do imply increases in water availability, but do not guarantee *per se* the satisfaction of water needs. However, water needs, intended as water demand, do not precisely correspond to water crop requirements, especially when water is provided at low costs, as it is traditionally in Italian agriculture, inducing inefficiencies in relative uses. Such a condition generates a diffuse attitude to treat water as a cheap input and to interpret water demand as *water needs at quasi-null costs* (Arrojo, 1999), implying the establishment of a vicious circle of rising demand – inadequate supply – increased (perceived) scarcity (Dosi and Easter 2000).

Indeed in the article 9, the WFD invites Member States (MS) to recover the costs related to water resources and the respective uses on the basis of the *polluter* pays principle. In this respect, the directive represents the first concrete attempt to associate an economic value to water resources by soliciting MS to apply adequate tariff systems and water price levels intended to guarantee the financial sustainability of water management and to incentivize a more efficient use of water resources, such to yield a reduction in water abstraction. As regard the improvement of water availability, instead, the article 4.7 could be interpreted as an opportunity of planning the construction of new water reservoirs, conditioned to at least the preservation of a good ecological status of the water body and to the predominance of economic and social benefits to the environmental and social costs.

To strengthen the quantitative aspects of water policy and to tackle the risks of droughts and water scarcity phenomena, the European Commission (EC) since 2006 has been working for the formalization of a guideline document of measures, in the form of a collection of recommendations, able to stimulate at EU level a better quantitative management of water resources, finalized to the improvement of water use efficiency and reduction of water losses, without meddling with the objectives of the WFD. Most relevance has been given to proven effective measures applied at different EU territorial levels for the agricultural sector, like the increase of water supply (in the spirit of art. 4.7 of the WFD), the application of water prices schemes and water metering (by backing the art. 9 of the WFD), the implementation of more efficient water allocation mechanisms, e.g. water use rights trading/exchange, as well as the integration of water related compliance measures with CAP subsidies.

The outcomes are collected in the document *Blueprint to safeguard Europe's water resources* (EC, 2012), which is an orientation policy document aimed at evaluating the existing EU water policies and to analyse the obstacles that likely hamper the implementation of the proposed measures. As regards the issues of droughts and water scarcity in the agricultural sector, the Blueprint proposes to enforce the application of art. 9 of the WFD (pricing and metering) and to foster actions for water use reduction as a pre-condition for accessing to Rural Development and Cohesion funds, together with the realization of a guidance document for the development of trading schemes for irrigation water use rights.

3.2. Water supply measures

Good examples of improvements of water supply for irrigation are initiatives devoted to the construction of small reservoirs, like the measure 125 (axes I) of the Rural Development Plan (RDP) implemented in the Emilia-Romagna region in Italy, applied primarily for storing water during winter periods and use it in summer as well as for limiting both the diffusion of in-farm small water reservoirs and the excessive withdrawn of underground water. The size of the reservoirs is limited up to 250.000 m^3 and is calibrated according to the collective size of the farms that are served. The users of the collective reservoir establish an irrigation board and set the rules for the management of the resource. Water reaches the farms only through pressure pipes, whose size is proportioned to the amount of water quotas entitled to each farm. Irrigation water is delivered through water meters and paid by a two part tariff covering the fix costs on the basis of the water quotas and the variable costs according to the volume of water used. Water quotas can be temporarily exchanged among farmers at the beginning of the irrigation season and the related costs are paid by the effective user. Despite the potential economic benefits accruing to the agricultural sector, the construction of collective reservoirs can be obstructed by environmental constraints and excessive capital investments.

Another potential measure to improve the availability of water resources for irrigation purposes is represented by the reuse of purified urban wastewater, whose validity as integrative water source is proved effective in arid semi-arid territories, like Southern USA, Middle East and Northern Africa (MIPAAF, 2011). However, for a matter of investment and operational costs of the wastewater treatment plants, the implementation scale of purified water for irrigation uses would be limited to agricultural areas surrounding large urban settlements, able to provide sufficient and constant availability of water during summer seasons. Other constraints to the diffusion of irrigation re-use of purified water is related to the potential difficulties in products marketing given the absence of agreed health standards at EU level for allowing the regular trading of the products (EC, 2012) and, in turn, the perception of unsafe product quality by costumers.

3.3. Water use efficiency measures

The other side of potential water policy measures addressing the issue of droughts and water scarcity is composed by economic instruments whose purpose is to induce improvements in efficiency of irrigation water use, a more rational allocation mechanisms of water resources among users and a better relation between quantity used, relative marginal value and cost distribution. As previously stated, remarkable importance has been given by the EC to the application and tuning of water pricing instruments, considered as a "powerful awareness-raising tool for users that combines environmental with economic benefits" (EC, 2012). Although the benefits in terms of use efficiency and resource conservation are well known, the efficacy of water pricing instruments is strictly subject to site-specific conditions (Johansson, 2000). Considerations about the interactions between type of water sources (underground, surface, artificial reservoirs), delivery systems (canals, pressure pipes), water management institutions (centralized, decentralized, water users associations) are essential for the correct design and the least-cost implementability of water pricing schemes. In fact, the dedicated institutions are subject to the risk of designing mechanisms that could prove to be unable to simultaneously guarantee the condition of optimality in water allocation and cost management (Johansson et al, 2002). For this reason, the feasibility of water pricing instruments hinges highly upon a careful management strategy capable to balance, *inter alia*, the requirements of efficiency in water use and fairness in costs' distribution (Dayton-Johnson, 2000; Rogers et al, 2004). In non-volumetric pricing schemes, for example, the tariff levels are usually set on criteria based on the presumed value of water uses in order to reduce the intrinsic asymmetric information issues caused by the inability of the management board to precisely discriminate actual farmers' water requirement. This condition creates potential unbalances between water allocation and costs' distribution that compel the water authority to intensify the monitoring activities and related costs. Volumetric schemes, instead, are more suited for guaranteeing a more equitable correspondence between efficiency of uses and relative values, but require high implementation costs, mainly due to infrastructure investments (pressure pipes, pumping stations) and administrative workloads. Usually, plans of implementation of volumetric pricing schemes are associate to technology (infrastructure) investments conceived to reduce water abstraction/consumption by inducing a more efficient use of the resource. However, in such cases the potential occurrence of the rebound effect (Olmstead, 2010) may jeopardize the expected outcome of water conservation if farmers are incentivized, by the adoption of the new technology, to expand their production and related water use.

Climate change sets a rapidly changing environment that potentially affects both the structure of the supply and of the demand of the water resources. On the supply side, climate change affects water cycles, by i) reducing the average water availability, ii) increasing the seasonal and annual rainfall variability. On the demand side, climate change triggers modification in the plant responses to such changes, increases the demand of water in case average temperatures rise, affects the overall irrigation plans, and due to the increased uncertainty, affects the utility of risk averse farmers. Administrative water allocation, given its inertia, is likely to fail in adapting to such changes, whereas WMs give the possibility to the resources to follow the time-by-time most profitable use. In this respect, water markets (WM) are proposed to substitute command and control policies for the allocation of the water resources, when water demand is greater than the availability. The rationale of water markets is that they theoretically lead to the equalization of the marginal value of the resource among the users, thus implying an efficient allocation (Schoengold and Zilberman, 2007). Further, WMs have the potential to avoid asymmetric information issues arising in other instruments, e.g. water pricing, since users will not be price takers subject to a centralized authority and the marginal value of irrigation water for each farmer will be expressed by the market clearing price (Tsur,

2009). However, asymmetric information problems can still affect the correct market mechanism especially when water use rights are allocated under condition of information asymmetries. In the context of climate change, WMs are likely to become more and more relevant. For instance, Frederick (1997) and Tietenberg (2003) highlight the added value that WMs have in potentially tackling climate change events, given their inherent flexibility. More than for others, water resources need an adaptive management that takes into account both changes in the supply side and the capacity of the demand to respond to such changes (Tietenberg, 2003).

Despite their promising advantages, water markets are rarely formally implemented throughout the world, like in USA (Howitt, 1998), Chile (Hearne and Easter, 1997) and Australia (Tisdell, 2011). The unique European experience is represented by Spain (Calatrava and Garrido, 2005). In Italy, WMs are not allowed by the national legislation, on the basis that water is publicly owned. Moreover, the national referendum of 2011 created a great societal involvement that prevented any scientific discussion on the topic. Generally speaking, in Italy WMs are often socially disapproved on a mix of ideological and ethic arguments. Clearly, the peculiarity of the resource at stakes imposes a careful analysis of any change in the allocation policies. However, relevant stakeholders often indicate the existence of informal water transfer based on barter agreements. The lack of a formal institution prevented a vast literature on the potentials for WMs in the Italian context. Pujol et al. (2006) compare a southern Italian with a Spanish case study to analyze the effect that different typologies of transaction costs (variable vs fixed) have on the potential water transfers among irrigators. Zavalloni et al. (2013) analyze the reallocation mechanism that is present in a number of rainwater harvesting reservoirs in the north of Italy, and compare it with a free trade arrangement.

3.4. Insurance instruments

The economic and policy instruments presented so far (par. 3.1 and 3.2) are intended, *inter alia*, to protect farms' economic viability but also to induce farmers to profuse efforts, in the limits of their possibilities, in adapting farms' management strategies such to mitigate the effects of unfavorable water scarcity and drought events. However, given the uncertainties concerning the evolution of climate change and related variability of extreme summer weather events, residual production and income risks would still persist despite the application of the instruments presented so far. In this respect, important room for the design and implementation of insurance instruments to cope with such systemic risks exist. According to European legislation and in compliance with WTO constraints, Member States can intervene to compensate income losses generated by unpredictable and accidental events whose high damage intensity and low frequency of occurrence make traditional insurance markets fallible. Such ex-post interventions, although useful and socially desirable for alleviating the drastic effects of unfavorable weather events, could represent an unsustainable burden on national and European finances. For such reasons, ex-ante instruments like mutual funds and weather index insurance would be more appropriate for coping with systemic risks and more efficient from a financial perspective to cover residual production and income uncertainties.

Weather index insurance has the characteristic of minimizing indemnity biases and transaction costs caused by asymmetric information and the financial exposure of the seller can be shared by allocating derivative products on capital markets (Turvey, 2001). However, the difficulties in devising weather indexes that correctly define the occurrence and magnitude of the extreme events make both the designing and the pricing of such instruments flawed (Richards et al, 2004).

The implementation of mutual funds has been evoked by the EU in several occasions since they might, *individually or jointly, completely or partially replace Community and MS's ad hoc emergency measures* (EC, 2005a; EC, 2005b). With mutual funds, the financial consequences of systemic risks are completely managed by the fund's members, who establish the consortium according to criteria of solidarity and trust in order to avoid asymmetric information biases. Each member contributes to the fund by depositing a yearly quota and receives an indemnity, corresponding to the covered risk, whenever undergoes income losses. Several factors, however, can hamper the implementability and viability of mutual funds, like *in primis* the size and duration of the consortium, which proportionally determine the amount of financial resources (accumulation of savings) collected over time and the relative coverage capability. Another limiting element is represented by the difficulties in reinsuring the fund or in associating it to other instruments able to share its risk exposure (derivatives). Lastly, the proposal of a mutual fund could encounter the diffidence of farmers because it does not provide sufficient incentives for participation. In that case, fiscal deductions and privileged interest rates on farmers' deposits could compensate for the ineffective appeal of the risk sharing nature of the funds (Cafiero et al, 2007).

4. PUBLIC OPINION

4.1. Social context in Italy

The feasibility of instruments that potentially affect the way a public resource is managed and its related juridical status is strongly tied to the social standings and to the opinions of different interest groups (Appelgren and Klohn, 1999). In this regard, it would be desirable that institutions establish a participative approach, as recommended by the WFD, in order to actively involve interested parties to the decision-making process.

In 2011, following numerous protests about the privatization of water management system, the Italian population decided, through a referendum, to reduce the presence of private companies in water management systems and to eliminate the rates of return on the capital invested for water infrastructures from the tariff. In that occasion, the Italian population re-affirmed its opinion about the public status of the water resources. Although such situations may be driven by a strong idealistic component, the low level of specific and definite information about the current and future issues at stake can play a remarkable role in public understanding, informed opinion-making and social sensitiveness.

For such reasons, our approach to the study of potential measures to be adopted in order to tackle the issues related to water scarcity and droughts in agriculture considers, as a first step, a sensitiveness analysis of the public opinion with regard to i) the state of knowledge about climate change scenarios, ii) the most suited instruments to contrast and prevent the potential effects of climate change on irrigation water resources, iii) the possibility of establishing exchange/trade mechanisms for improving water allocation among farmers and between agriculture and other economic sectors.

4.2. Data collection

Two surveys have been carried out by submitting questionnaires to participants and attendees of the Science Festival in Genova and the H2O Congress in Ferrara in 2012.

The questions submitted at the Science Festival were intended to gather information about:

1. the potential combined effects of the evolution of population behavior with respect to water resources (water saving, conscious water consumption) and climate trends (water scarcity);

2. water governance solutions by evaluating the potential joint effects of development/adoption of technological innovations and institutional/normative adaptations;
3. suitable water management options in the Italian context (efficiency improvement, pricing policy, pollution reduction et al);
4. the perception toward the use of monetary compensations for determining preferred allocation solutions for potential competing water uses.

About 100 interviews were handed out and a total of 55 were returned. The respondents come from different economic sectors, 52% were female and an average age of 42 years was recorded.

The surveys submitted at the H2O Conference in Ferrara focused more on the potential development of water markets in Italy. Here, we report the collected responses to specific questions about:

1. the combined effects of the institutional framework evolution (adaptation for water markets development) and climate change (reduction of water availability, increase in climate weather variability);
2. the most suitable improvements/modification in water management;
3. the opportunity of developing both intra-sectorial (agriculture) and inter-sectorial water markets, given the present juridical framework, and related economic effects;
4. the likely impediments for the development of water markets in Italy.

About 50 questionnaires were handed out and only 14 were returned, filled up by specialized professionals, mostly expert in the field of water management, coming from universities, research institutes, and water board organizations.

4.3. Descriptive statistics

A summary of descriptive statistics, in average terms, of the results is presented according to the format used for submitting the questions.

4.3.1. Results from Science Festival surveys

Table 1. What probability do you associate to the following scenarios?

		Climate	
		Stabilization	Change according to present trend
Population	"Virtuous" evolution (conscious water consumption, water saving)	A. "Business as usual" Ecofriendly 20%	B. Potential availability-driven crisis 28%
	Change according to present trend	C. demand-driven crisis 26%	D. Heavy water crises 26%

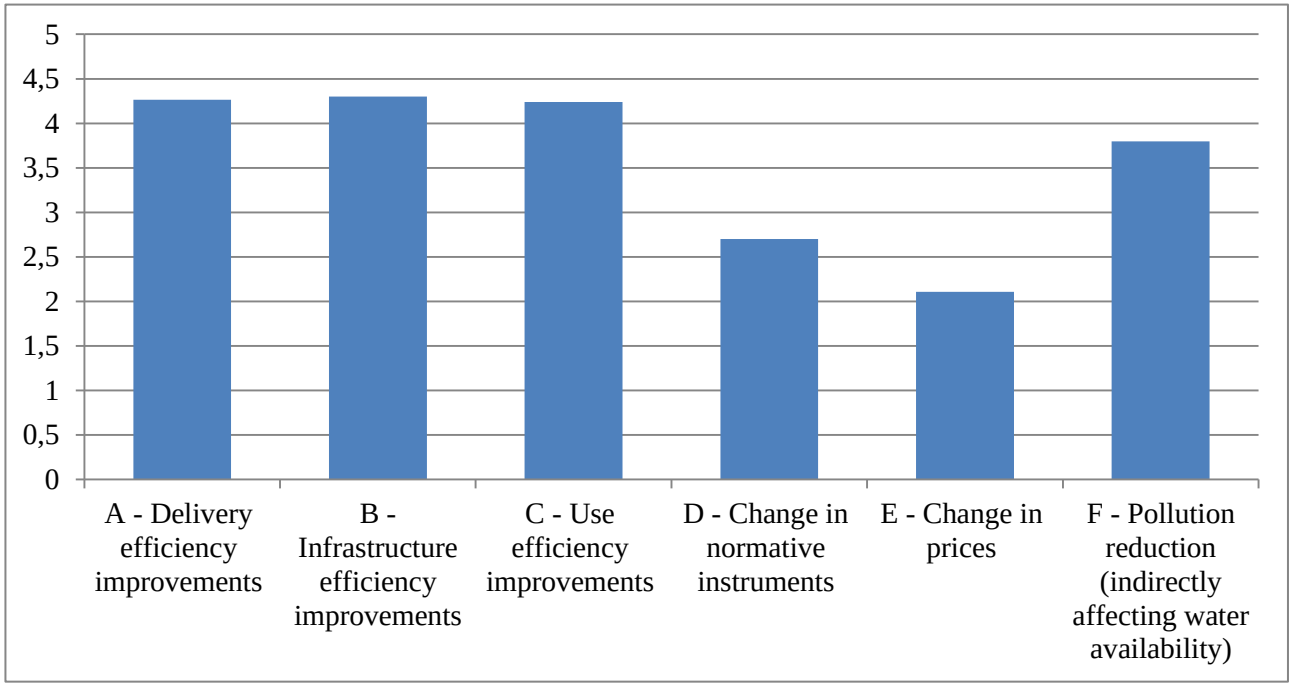
The average of the percent values shows that respondents are more prone to believe that changes will take place more likely than a situation of stability either in population behavior or climate and in both. Hence, they expressed a convinced opinion about the possibility of future water crises.

Table 2. What probability do you associate to the following scenarios?

		Governance solutions	
		Norms/governance adaptation	Present norms/governance
Technological solutions	Keeping abreast with needs	A. Maximum adaptation/flexibility 20%	B. Prevailing "technological" solutions 32%
	Not keeping abreast with needs	C. Prevailing "socio-economic" solutions 25%	D. Maximum rigidity/crisis likelihood 23%

The results highlight the prevailing skepticism of respondents with respect to the possibility of governance/norms to adapt to future climatic condition. In contrast, respondents sensibly rely on the adoption of technological solutions for preventing water scarcity and droughts effects.

Figure 1: According to your opinion, what changes in water management will be mostly desirable in the Italian context (1: the lowest – 6: the highest)?



Consistently with previous results, respondents considers efficiency improvements, along with pollution reduction, the most suitable solution for mitigating the risk of reduction in water availability.

The last section of the survey proposed to interviewees to choose between two mutually exclusive options regarding the hypothetical scenarios of i) compensating farmers that renounce to draw water in order to make it available for civil/domestic uses and ii) giving up, on compensation, to a part their water availability in order to guarantee irrigation uses for farmers. The “compensation to farmers” scenario, which indirectly elicits the willingness to buy water from another sector, received about 55,8% of positive consensus (24 out of 43 respondents), while the “compensated by farmers” scenario, which indirectly elicits

the willingness to sell water to another sector, recorded about 71,1% of positive responses (32 out of 45 respondents).

The fact that respondents reacted positively to the opportunity of exchanging water for money is surprising, mainly because, being most of them not engaged in agricultural activities, they do not know how much value could be associated to a unit of irrigation water. Notwithstanding this, the result highlights that at least people are prone to intervene directly, by buying or selling water, for finding a solution to a severe problem. Indeed, about 36% of the interviewed answered concordantly to both options, showing a positive propensity to engage in an exchange/trading scheme. More precisely, a quota of about 74% would choose option b (selling), while a share of 57% for option a. A complete disagreement is, instead, expressed by the 12% of the respondents.

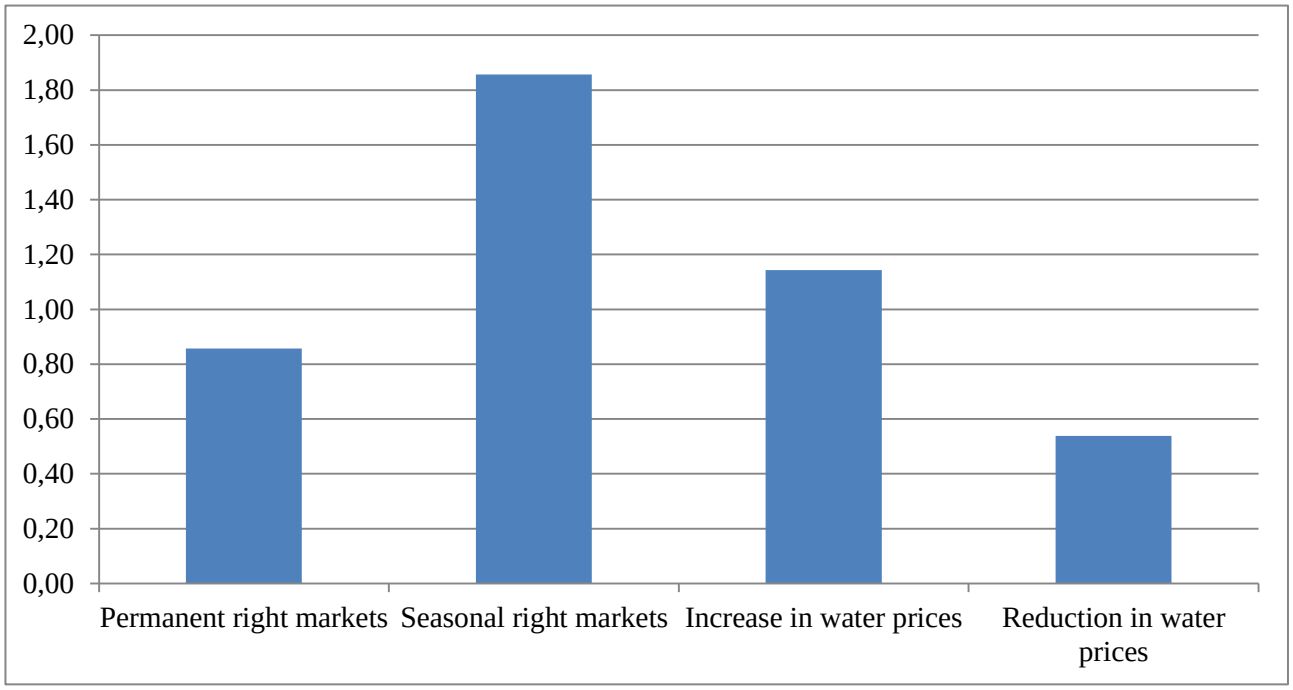
4.3.2. Results from H2O Congress surveys

Table 3. What probability do you associate to the following scenarios?

		Climate Change	
		Minor changes	Significant reduction in water availability; Significant increase in water variability
Institutional evolution	Minor adjustments	A. No relevant changes 25%	B. Increase in insurance demand; Informal water market development 38%
	Major changes toward the arrangement of formal water right markets	C. Compensation tied to local droughts and/or emergencies; Arrangements of intra-sectorial markets, in particular, the development of option right markets 18%	D. Significnat improvement of formal market mechanisms; Allowance of intra- and inter-sectorial water exchange; Extensive option right exchenges 19%

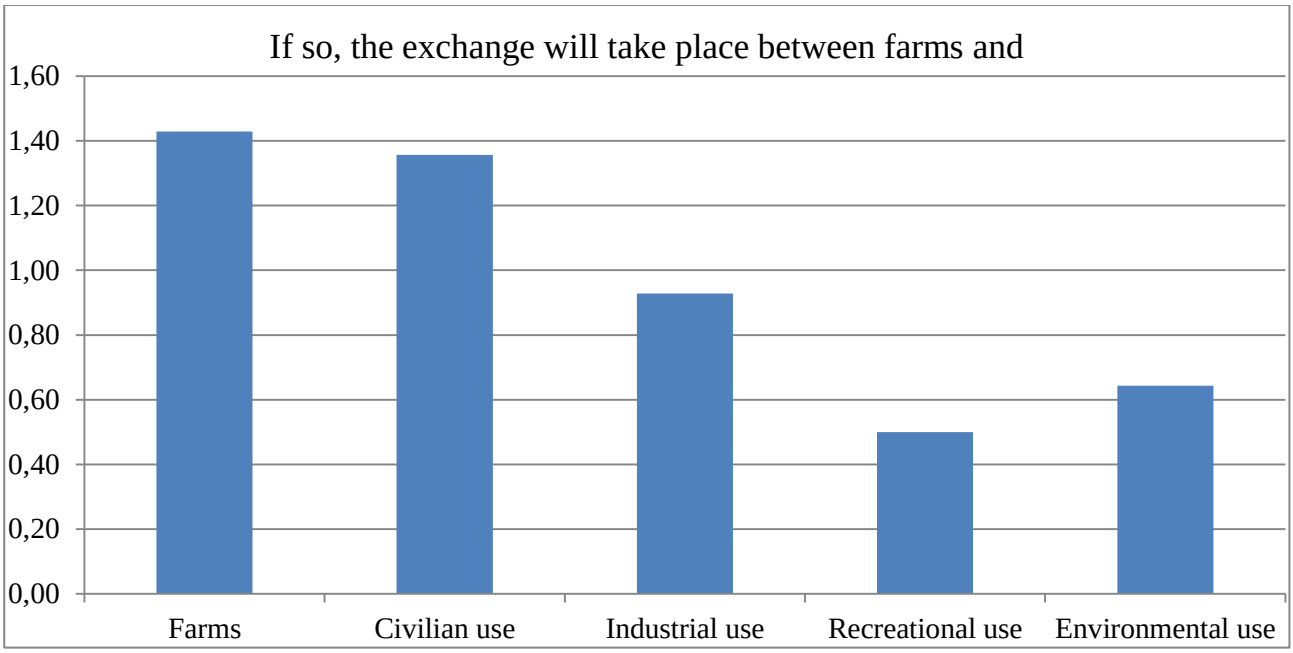
The results show the respondents belief in a remarkable inertia of institutions that do not adjust according to the changes in the climatic conditions. The most probable scenario, according to the interviewees, is scenario B characterized by major changes in the climatic condition, facing minor institutional adjustments.

Figure 2. What you think would be the most helpful changes in agricultural water management, with respect to the issue of water scarcity (1: the lowest – 4: the highest)?



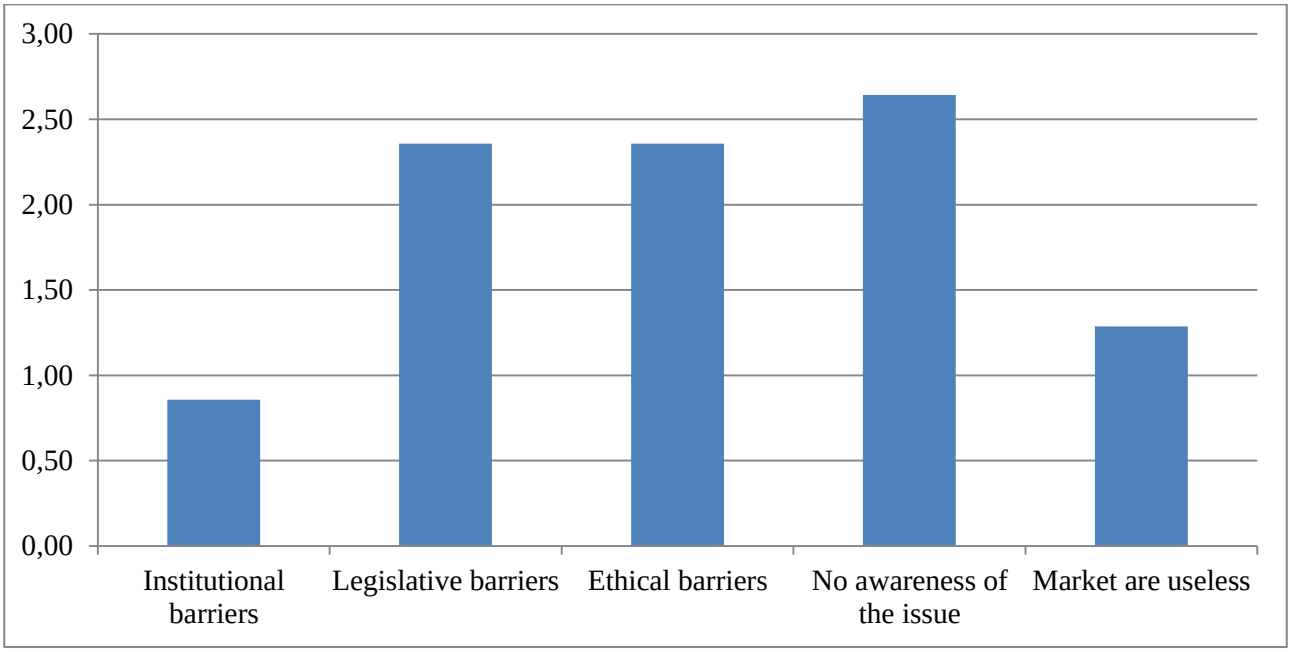
The interviewees see the seasonal right markets as the most helpful tool to be used for the agricultural sector to cope with the potential water scarcity. Quite interestingly, there is a consistent pattern across the answers: since the seasonal scarcity is the main problem, seasonal markets are considered to be the solution.

Figure 3. Do you think the exchange of water among farms and/or other agents would be allowed within the current legislative setting (1: the lowest – 5: the highest)?



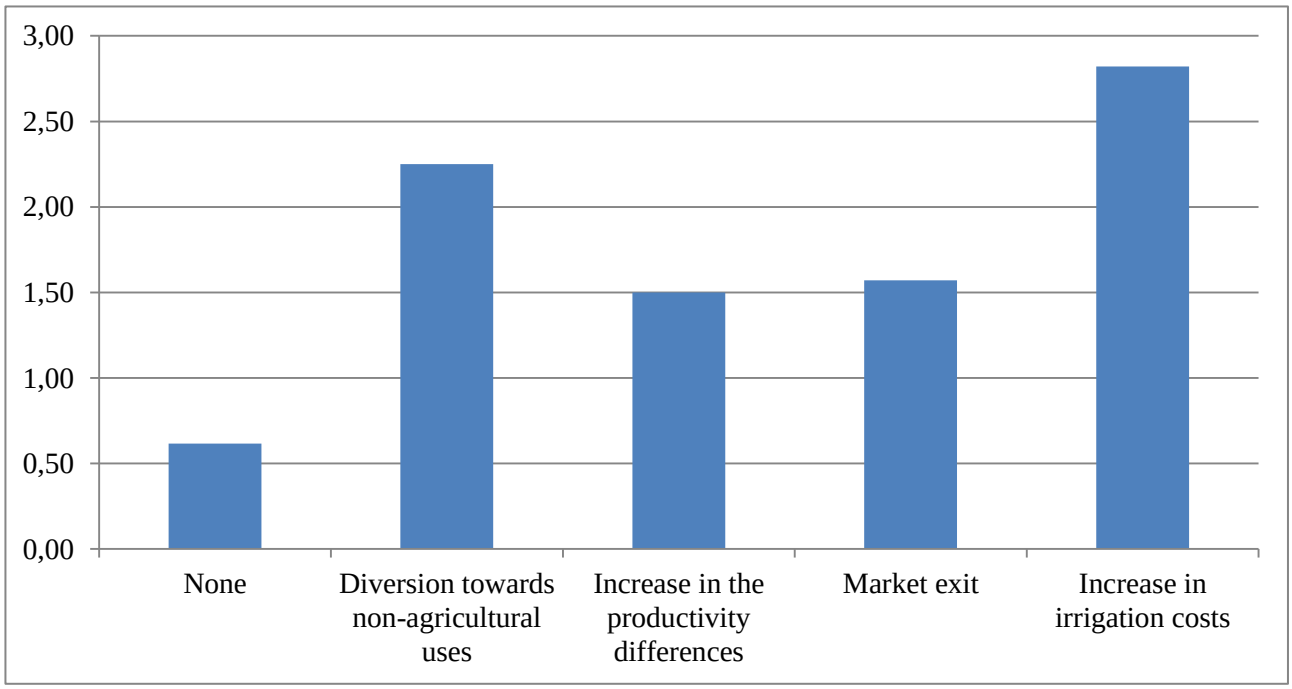
Most of the people answered positively, indicating that agriculture and domestic economy are the most likely sectors that could benefit from the development of water exchanges within the current legislative framework.

Figure 4. What do you think are the barriers against the establishment of the agricultural water markets in Italy (1: the lowest – 5: the highest)?



According to the interviewees, the main barriers against the establishment of agricultural markets come from society, or more precisely from the lack of awareness of the problem. Moreover, equally important are the legislative and ethical barriers.

Figure 5. What do you think are the main negative consequences of the establishment of agricultural water market in Italy (1: the lowest – 5: the highest)?



According to the respondents, which are water issues experts, in case the water right markets for agriculture are established, the main negative consequence of such an institutional evolution will be an increase in the irrigation water costs, followed by the diversion of the resources towards non-agricultural uses.

5. DISCUSSION AND CONCLUSIONS

Several "foods for thought" emerged from the description of the data on how to effectively approach potential future discussions about the relationship between water scarcity and droughts issues, related adaptation measures and social opinions about the theme. First of all, there is a diffuse perception about the actuality of climate change effects on water resources (Tables 1 and 3), even though scientific uncertainties about the future magnitude of the events and lack of media pervasiveness about the phenomenon still exist. The application of measures devoted to improve the efficiency in all aspects of water management received a remarkable consensus (Figure 1), together with a trust in the future development and adoption of *ad hoc* technologies (Table 2) devised to reduce the exposure to the risks of reduced water availability. Less credible, instead, resulted the hypothesis of a timely institutional and normative adaptation (Tables 2 and 3).

The collected data suggest that the proposal of envisaging water exchange/trade mechanisms aroused unexpected openness (Figure 3), especially with regard to the use of such instrument to reduce seasonal imbalances of water allocation, both for farm-to-farm and for agriculture-domestic transfers (Figure 3). However, people expressed perplexities about the possibility of implementing water transfers mechanisms in Italy, mainly because of the potential negative effects on irrigation costs, the threat of water diversion out of agriculture as well as the prevalence of normative and ethical barriers (Figures 4 and 5).

The former point may have been led by a confusion between privatisation of water supply, that is in fact consistent with an increase in water price, and actual water trade among right owners, which would not necessarily affect the initial costs for water and rather provide better profitability of water use.

Public opinion plays a decisive role in the decision-making process regarding variations in management of water resources (Keenan et al, 1999). All the more so in Italy where the adoption of economic and policy instruments is subject to the compliance with traditional social norms that have driven the evolution of water management according to the principles of social fairness and mutuality in water use. For this reason, the wished positive social acceptability of economic and policy instruments is conditional to "contingent feelings", and their evolution over time, with respect to variations in water management as well as to the risk of generating conflicts between interest groups. One way to reduce social divergences, and unconcern as well, is to provide population with diffuse, correct and intelligible information about the phenomena under interest, in this case climate change, and the related menus of options to choose from, in this case the economic and policy instruments (e.g. water markets). Thus, the single individual is induced to rely more on his/her perception of the issues at stake and to weigh his/her opinion with respect to the social environment in which the decision are to be made (Teraij, 2007), avoiding the frequent occurrence of "herd" behaviours (Banerjee, 1992). Further, information dissemination promotes the creation of a quite social environment, within which to establish a clear decision-making process, and fosters the convergence towards the establishment of a necessary common vocabulary between stakeholders in water policy (Hoekstra, 1998).

Extreme importance in this context is played by the role of research. Producing information about the relationships between climate change effects on water scarcity and droughts and potential economic and policy instruments is necessary, but not sufficient *per se* to set the right decision-making path in water management. More is needed to know about contexts and reasons affecting the social acceptability of specific instruments, especially for evaluating the potential development of water markets in Italy. To this regard, accurate investigations have to be carried out for determining the suitability of different types of exchange mechanisms according to their capacity of guaranteeing acceptable levels of profitability for water market's agents. Eventually, potential implementation strategies have to be proposed and designed (negotiated) according to the findings of the preceding research steps such to minimize the effect of any possible distortive element that could be found along the whole decision-making path.

In addition, design of potential water trade institutions has to carefully take into account limitations and boundaries set by public opinion and supporting local regulation, considering appropriate limitations to trade in order to benefit of the trade mechanism minimising potential distortions. This includes, for example, clear definition of property rights, establishment of a cap on aggregate water use, compliance with recognised priorities of use when allowing trading, appropriate institutions to manage water exchanges, etc. A key challenge for economic research is to address water markets ex-ante taking properly into account this wide range of institutional issues, which are the key for both acceptability and performance of water markets.

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