Fourth Conference of the Italian Association of Agricultural and Applied Economics (AIEAA) Ancona, June 11-12, 2015.

Modelling contracts for irrigation water under adverse selection

Keywords: adverse selection, asymmetric information, principal agent model, menu of contracts.

Introduction

The concept that water is a scarce economic goods is increasingly accepted (ARCADIS, 2012; Tang et al., 2013). Water resource has a very high economic value because it is limited and due to the fact that it is capable of being applied to many different uses (Ward and Michelsen, 2002). Water resources can be used for agriculture, industry, energy and human being. Thus, it is an increasing concern to the policy makers to make a trade-off for such a scarce resource and providing a sustainable allocation through designing different mechanisms.

Particularly, this research observes the agent's performance when the principal design a contract and proposes to the agent, who is in possession of some private information about his heterogeneity and shows his readiness to accept the contract or not.

The main objective of this study is to develop a theoretical approach to exploiting a new model which reduces the cost of adverse selection and to provide a worthy framework to better understand consequences of asymmetric information. Additionally, we try to show how can be modernized the water managements through a solid mechanism and efficient water charging in area study.

Methodology

In this paper we try to give an overview about relationship between water regulator and water users based in empirical data taken in Çukas (i.e. region of Albania) case study. The research evaluates alternative water pricing options using a principal agent model, in order to provide appropriate menu of contracts among different agents, following the model developed by Viaggi et al., (2010) and based on an adaptation of Moxe et al., (1999).

The principal might be government, local institution or another institution which provides the menu of contracts for agents, which are represented by farmers who have an information advantage in term of their costs.

The non-linear model is build up through a mathematical formulation in order to design the menu of contracts to achieve the objective. The model is constrained in two farm types, then farmers (agents) are free to choose among the set of contracts from the menu, and the agent has an inalienable right to replace the contract's conditions, due to this becomes a principal's problem.

The objective function is that utilitarian regulator aims to maximize the social welfare function via offering suitable contracts for all agents. Considering that agents are profit maximizes and the difference between each other is by their productivity, high productivity type (i=1) and low productivity type (i=2). Correspondingly, the high productivity type uses a high input than low productivity type. However, the regulator provides price discrimination "p_1 and p_2" for water absorption, where the p_1 is the payment for irrigation water for the high productivity farm type and p_2 signify the payment for irrigation water for low productivity farm type.

The principal is in position to offer the menu of contracts, which must be suitable for different agents such that high productivity type to prefer the contract designed for him and the same for low productivity type. Since the regulator cannot observe farm's behaviour, for him become a problem revealing the farm choice from the set of menu of contracts. Generally, the principal has difficulties to reveal farm's information without receiving some cost.

If the regulator was able to observe farm types, the regulator would provide for farmers the menu of contracts that is the utility earned from the contract mast be greater than the farm's reserve utility. Thus, the marginal social cost is equal to the marginal social benefit, which happened in first best or under perfect information (Moxey et al., 1999). As the regulator is characterized by asymmetry of information, and being uncertain about farm heterogeneity, it is not possible for him to achieve the firs best allocation of resource, due to there is an incentive for farmers to cheat, choosing the contract as another farm type. This adverse selection is costly for the regulator because his utility function is reduced.

The challenge for the principal is developing a mechanism design which provides a menu of contracts where the agent's utility from the contract to be higher than his reservation utility out

the contract, also to be higher than his utility received choosing the contract intended for another farm type.

Even under adverse selection, those allocations can be characterized once one has described set of constraints (Laffont and Martimort, 2002): *incentive compatibility constraints* which remove the incentive for any agent to declare himself as another agent, *participation constraints* must also guarantee that each farmer is incentive to choose the type of contract that is designed for him.

Since first best was not feasible, in order to achieve the optimal solution, the principal can influence the agent's information elicitation decision by offering more contingent pay, (Garcia, 2014) or by reducing his cost of resource in such a way that make him incentive compatible.

Results

According to the preliminary results of this paper, it is observed that hidden information (adverse selection) impedes the adoption of modern tools in irrigation water charging. Nevertheless, by providing a menu of contracts which offers price discrimination for agents is achieved an optimal solution for water users and regulator itself. The first best contracting will work in theory if the regulator has enough information about agents, but in practise is difficult to think that first best will work, due to regulator would not have the detailed information about the agent’s characteristics to offer such menu. In the presence of private information principal may set substantially smaller prices than they would do in the good state of nature when there is perfect information (Hoppe and Schmitz, 2015) in order to making the high productivity type indifferent to take the contracts decided for low productivity type. Hence, the optimal solution is achieved in second best of menu of contracts, and is one which guarantees that each farmer chooses from the menu the contract that is designed for him rather than to cheat. Furthermore, in

second best of menu of contracts by shrinking the cost of water to the high productivity type, incentive compatibility constraints and participation constraints are satisfied. Yet, the social welfare under first best menu of contracts remains always higher than the social welfare in the second best, and this happen due to information assumptions are different. However, even under adverse selection, though a mechanism design the principal riches allocation efficiency.

Conclusion

The purpose of the study is to provide a theoretical framework which shows how can be minimized the cost of information between principal and agent. In addition, in this paper we attempts to show that menu of contracts can be an appreciated instrument or can take place as an alternative approach of water pricing among farmers.

Based on the preliminary results, numerical differences among different menu of contract solutions are very narrow. This outcome is as consequence of limitations in finding suitable data to prove the model. Nonetheless, the paper still requires additional improvements and review in order to assimilate such issue. Hence, in future our intention is to develop more the mechanisms of water charging and to examine the design of appropriate menu of contracts for water users with respect to the asymmetric information.

References

1. ARCADIS. (2012). The role of water pricing and water allocation in agriculture in delivering sustainable water use in Europe. Final Report.
2. Garcia, D. (2014). Optimal contracts with privately informed agents and active principals. *Journal of Corporate Finance* 29: 695-709.

3. Hoppe, E. I. and Schmitz, P. W. (2015). Do sellers offer menus of contracts to separate buyer types? An experimental test of adverse selection theory. *Games and Economic Behaviour* 89: 17-33.
4. Laffont, J. J. and Martimort, D. (2002). *The theory of incentives. The principal-agent model.* Princeton University Press, Princeton.
5. Tang, Z., Nan, Z., Liu, J. (2013). The willingness to pay for irrigation water: A case study in northwest china. *Global NEST Journal* 15 (1): 76-84.
6. Viaggi, D., Raggi, M., Bartolini, F. and Gallerani, V. (2010). Are simple pricing mechanisms enough? Designing contracts for irrigation water under asymmetric information in an area of Northern Italy. *Agricultural Water Management* 97 (9): 1326-1332.
7. Ward, F. A. and Michelsen, A. (2002). The economic value of water in agriculture: concepts and policy applications. *Water Policy* 4: 423-446.