Understanding the Demand for Water Services in the Spanish Agriculture: The impact of the Common Agricultural Policy Reform[1]

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(First draft: Comments welcome)

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Assessing the impact of prices and other policy measures designed to reduce water use in the Spanish agriculture, and accommodating water demand with the increasingly scarce supply in the recurrent shortage periods, requires a clear understanding of the logic behind the farmers' decisions. In other words, the analysis of the expected impact of water policies in the agricultural sector, including water charges, the improvement of the existing irrigation devices and the development of new irrigated areas, requires the previous understanding on how crop decisions are taken and on how this decisions might change in the presence of a policy shock.

In this sense, during the last years there has been an increasing interest in Europe in analysing the linkages between the agricultural policy, mainly designed to promote production, and the water policy, oriented to the enhancement of the efficiency in the use of water resources an to the improvement of the ecological quality of the water ecosystems degraded as a consequence of water extractions, river diversions, impoundment, pollution and other pressures originated by the economic uses of water services in the agriculture and other production and consumption activities.

More specifically, a recent discussion in the European Union and in Spain focused on the likely impact of the Common Agricultural Policy (CAP) Reform, consisting basically in the decoupling from production of farmers subsidies that in the future will be transformed from production subsidies to income support, and the protection of aquatic ecosystems. According to some authors, the CAP reform may result in

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important reductions in farmed surfaces and then in reductions of water demands and improvements on water ecosystems. According to others, the CAP reform may be understood as an institutional change where the model of European agriculture will shift from a highly regulated and subsidised into a market oriented and competitive activity; in this respect the change may result in an additional supply of water and irrigation devices giving the opportunity to increase the production of water and non point pollution intensive agriculture oriented to market incentives.

The way CAP reform will affect water demand depends on many local characteristics including land orientations, expected yields of different crops, water prices, availability of irrigation facilities, etc. For this reason in some regions the CAP reform may be an opportunity to reduce water use and pressures on surface and underground waters. In other cases, the CAP reform may represent a challenge to accommodate new pressures with increasingly stringent requirements of ecological quality of water ecosystems. The main purpose of this paper is to develop a general methodology to determine the effect of the CAP reform on the water demand. The second purpose is to understand how the new institutional framework will change the shape of the agricultural water demand and how this change will affect the effectiveness of increasing water charges as means to reduce water use. The methodology presented in this paper is tested in a case study, where the required information is available, to the Campiña Baja Irrigation District in Cordoba Southern Spain.

1. The policy Framework: The Water framework Directive and the Common Agricultural Policy.

The key objective of the WFD is to achieve “good status” for all waters by 2015. Further aims of the Directive are to prevent further deterioration and to protect and enhance the status of aquatic ecosystems, to promote sustainable water use based on a long-term protection of available water resources, to progressively reduce discharges and emissions of certain priority substances and to contribute to mitigating the effects of floods and droughts. In south Spain, agriculture’s demand of water services represents 80% of water consumption and is the one of the most important sources of the non point emissions of nitrates and other chemical pollutants that reach surface and underground

waters. Additionally, the water demand for agriculture is the main reason for many hydrological modifications, such as dams, channels and irrigation facilities, and so forth. Given its relative importance, the ability to meet the WFD objectives will critically depend on the capacity to understand the agricultural sector and to identify opportunities to make the agriculture compatible with the improvement of the quality of the water ecosystems as important assets for the rural economy.

For the assessment of the different measures and actions plans that may be implemented by member states to reach the WFD's aims, it is necessary to have a baseline scenario to evaluate the potential gains of the different water saving measures, pollution reduction alternatives, and ecosystem restoration projects and their potential contribution to the improvement of the waters ecological status. In the case of the agricultural sector this baseline scenario can not be constructed by the projection into the future of the observed past trends of crops production and water uses. This is so because, in most rural regions in Europe the current structure of the agricultural sector is mainly explained by the existing trade barriers, production subsidies and the many public sector actions that determine the financial incentives of the sector. But, given the changing economic environment, the future of the rural sector will depend less on past patterns and inertia than on the important changes in market forces and institutional policies.

Apart from changes in local policies, including public supported new irrigation facilities, the prospects of the European agriculture depends on the advances in trade liberalization, including many trade agreements and the application of the Uruguay Round compromises, and on how the mid term revision of the CAP will affect the structure of the sector and the demand of water services.

The so-called ***Mid-Term Review*** (MTR) of the CAP was motivated by the need to make the European Agricultural policy compatible with the World Trade Organization agreements, to facilitate the EU enlargement process, and to respond to social increased pressure for stronger environmental protection. In general terms, the CAP reform will give farmers greater freedom to decide what crops and livestock to produce. Under the reformed CAP, instead of having to produce particular products to obtain agricultural

support, farmers will be able to choose what and how much to produce purely in response to market demands.

The main changes introduced by the Mid Term CAP reform are:

- The decoupling of direct payment to farmers from production. Instead of production subsidies, these payments will gradually become income transfers with no effect on crop and cattle decisions. This might have important consequences on the structure of the sector and over its demand of water services.
- Payment of Income transfers will increasingly be conditional on compliance with environmental, food safety, animal welfare and occupational safety standards. This might represent an important opportunity to increase the WFD possibility of success.
- Support for rural development. This may represent an opportunity to coordinate rural development, and agricultural policy, with the improvement of the ecological quality of water ecosystems.

2. Objectives and Scope of the Case Study

The importance of these changes, the opportunity they represent and the importance of agriculture for water policy, are all elements to justify the development of analytical tools with the capacity to provide reliable information on the prospective effects of the reform. The present document aims to provide a tool to assess the likely impact of the CAP reform on the agricultural sector activity, in general, and particularly on the use of water services.

The CAP reform will make crop decisions increasingly more dependent on market incentives and some changes can be expected regarding the demand of water services. A likely effect will be the reduction of subsidy supported crops. Moreover the final effect on the demand of water services will depend on how farmer's decisions are adapted to the new situation and on the incentives to use the excess production factors, in particular land and water, to increase the cultivated area of other market crops. The combination of this reduction and substitution effects will finally determine the effect over the

demand of water services. These effects are highly dependent of local conditions and can not be generalised from one region to another.

Another important aspect to be considered is how the new situation will affect the ability of the agricultural sector to respond to water prices and incentives. The CAP sets different incentives to farmers regarding water use and these incentives have a large influence on water use decisions. Additionally some of the existing water pricing policies may be working against the incentives that a sustainable water pricing system is expected to convey, e.g. by setting a water price independent of the quantity of water effectively used or by charging effective prices that only cover part of the financial costs of water services. The new context created by the CAP reform will also change the way farmers respond to water pricing. These pricing incentives aiming at the sustainable use of water is one important part of WFD implementation, and is strongly linked to cost recovery and the polluter-pays-principle. Understanding farmer's responses to incentive water pricing is crucial in order to support practical implementation of the WFD. The second important objective of this paper is to provide an illustration on how to assess the impact of water prices on the agricultural sector and its impact on water savings.

The design and implementation of the river basin management plans require the use of economic data to support and guide a range of decisions including RBD characterisation of the selection of mitigation measures to meet good status and determining appropriate use of the exemptions. These economic assessments will look at the economic and social costs and benefits of measures, as well as the environmental ones. When considering agricultural activities, this will mean that other important effects of the River Basin Management Plans including changes in employment, rural income need also be taking into account in the decision process. The third objective of this document is to illustrate some of these indirect effects can be determined.

3. Methodology:

The Water Economics Group of the Spanish Ministry of the Environment has develop a particular model for the economic analysis of the Spanish agriculture. The model of decisions of Spanish irrigated known as MODERE by its acronym (MOdelo de DEcisión del Regadío Español) is a simulation model that uses a purposely designed

database to identify what and how important are the criteria used by Spanish farmers when deciding land allocations to different crops depending on productivity, expected profits, risk and management complexity. Once calibrated the model is able to reproduce current farmer's decision and to simulate how these decisions will change in response to changes in prices, production costs and inputs availability. The software and the database, allows the implementation of the simulation model at different scales including farms, municipalities, irrigation districts, river sub basins, and so forth allowing taking into account local characteristics like soil potential, land vocation and water costs and irrigation requirements that are important to understand farmers behaviour.

4. Irrigated Agriculture in the Campiña Baja.

The study area is the Campiña Baja Irrigation District (Comarca), with 58,000 Hs distributed in sixteen municipalities in the province of Cordoba, including its capital city, in Andalucía southern Spain. Cereals occupy one out of any three hectares, mainly wheat and corn, which together with industrial crops such as cotton and girasol oil seeds, represents 60% of the irrigated land Olive trees represent 15% of the surface and fruits and vegetables 10% followed by a variety of different crops of a lower importance. The irrigation district obtain a production value of 148 million euros and capture CAP production linked subsidies of 32 million euros giving a total gross income of 180 million euros. When variable production costs are deduced it remains 106 million euros to cover capital depreciation, land rents and farmers income. As can be deduced from above, the production costs in the region are not relatively intensive in labour or intermediate inputs, such us hired works and fertilizers. The average net variable margin per hectare is higher than 1.800€ per hectare. When compared with the average margin of rain fed agriculture, lower than 300€ it is easy to understand the critical importance of having access to water and irrigation facilities. Farms receive a total of 312 cubic hectometres that are applied to crops with an average efficiency of 75%.

76% of the irrigated surface is covered by production linked CAP subsidies for an average value of 720€ per hectare, and obtaining an average net margin of 1300€ (580€

when considered net of subsidies). Non CAP supported crops leave an average variable margin of 3,400€ per hectare. Additionally, CAP crops are more water and household labour intensive, using an average of 5,500 cubic meters per hectare (compared to 4,150 of non CAP crops) and an average of 12 working days per hectare (7 of them being family labour). Contrary to that non CAP crops are relatively more labour and fertilisers intensive demanding an average of 17 working days per hectare (13 of them being hired labour) and 131 kg of nitrate based fertilisers per hectare.

Water productivity, as measured by the variable margin obtained per unit of water delivered to the farm, averages 0.30€ for the CAP supported products (being only 0.14€ when subsidies are deducted) compared to 1.1€ that is obtained as a net margin with the non CAP products.

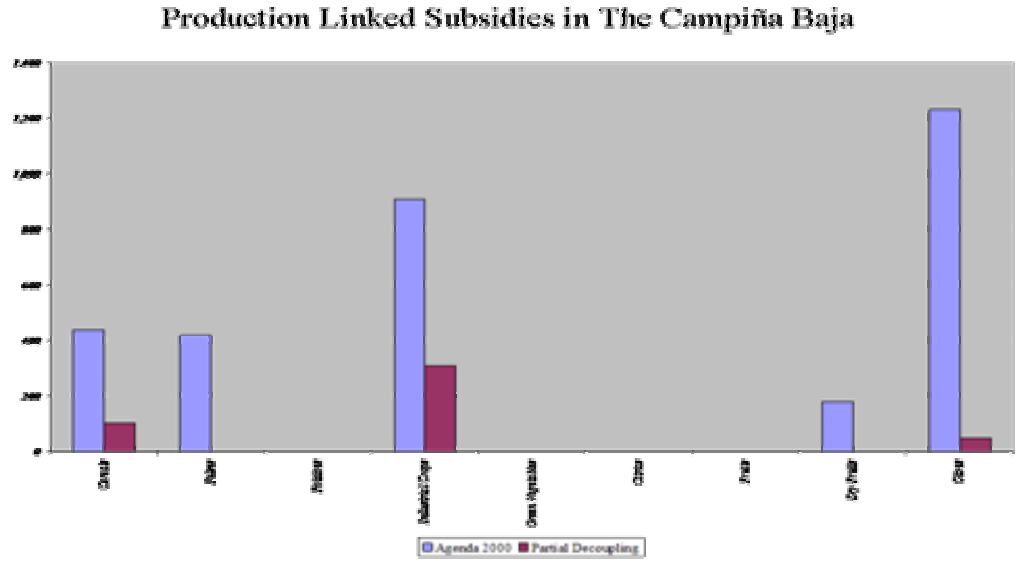
Non CAP crops are definitely more profitable on average, more efficient on the use of water and have a higher capacity to generate links with the local economy as a consequence of the demand of hired labour and intermediates. Departing from these facts we could deduce that decoupling of CAP subsidies might result in the abandon of traditional crops and an increase in the area dedicated to vegetables and other more profitable crops. Nevertheless, as is well known in the agricultural economics literature, farmer behaviour in developed countries may not be interpreted only as the consequences of expected benefits and costs. Some factors such as lack of labour at peak times, market risk, working capital constraints, etc. may explain adoption of less profitable crops. Compared with traditional subsidised alternatives, the option to plant commercial products, as green vegetables involves a higher risk (as measured by the standard deviation of prices and yields) and requires a more complex management strategy. The analysis performed of current farmers' decisions criteria in the Campiña Baja Irrigation District reveals that risk avoidance and simple crop management are relevant criteria to interpret farmers' decisions. Another important reason is the fact that the heavy dependence on tradition and finally, permanent crops (like fruits and olive trees), make difficult to revise decisions at least in the short term. In this respect, conservative decisions and inertia becomes important reason to explain how farmers will adapt to a changing political environment.

5. Simulation Scenarios:

Below we present the main results obtained by the simulation of three scenarios:

- The first scenario is the baseline and considers the current situation of the irrigation district under the Agenda 2000 framework.
- The second scenario represents the decisions taken by the Spanish government in 2004 and considers the partial decoupling of CAP subsidies.
- A third counterfactual scenario considers the effect of a complete decoupling of CAP subsidies.

Figure 1

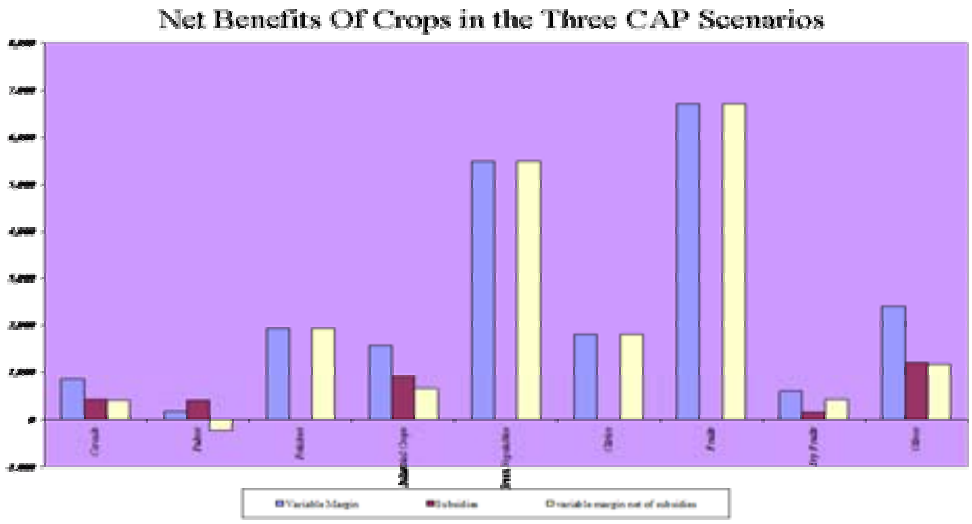


As shown in Figure 1, in the baseline situation crops receive a crop area weighted average production linked subsidy equivalent to 690€ per hectare, distributed among the different crops ranging from 1,200€ per hectare received by olive trees to 180€/H received by dry fruits, industrial crops receive 910€/H and cereals and pulses 440€. In static terms the elimination of subsidies would reduce the variable margin of CAP supported crops from 1,330€/H to 640€/H, showing that even without subsidies irrigated crops retain an important comparative advantage with respect to rain feed agriculture in the region, and rainfed crops will also reduce profitability as they also

depend on CAP subsidies. Olive trees leaves the higher variable margin of 2,400€ per hectare, that might be reduced to 1,200€ in case subsidies were eliminated. The net margin (without subsidies) of industrial crops and cereals is 660€/H and 420€/H, and pulses is the only crop in the region which variable margin would become negative in case of full decoupling of production subsidies.

To implement the mid term revision of the CAP, the Spanish government has chosen a partial decoupling options consisting in an asymmetric reduction of production linked subsidies that given the average yields in the Campiña Irrigation District will lead to a land use weighted average subsidy of 190€ per hectare for CAP supported crops. In other words, 30% of the financial aid received by crops will remain linked to production levels. As shown in Figure 2, production linked subsidies to olive trees was reduced to 10%, cereals to 20% approximately and and 30% for industrial crops, finally they were completely decoupled for pulses.

Figure 2



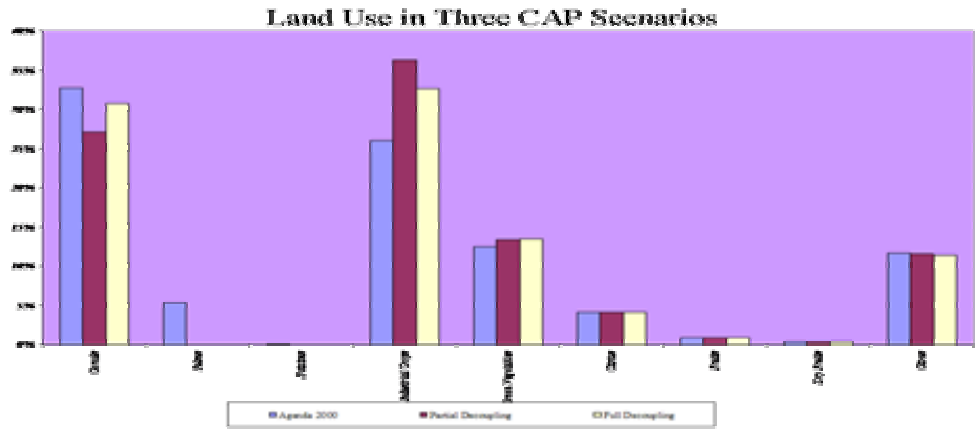
The above mentioned two scenarios are compared also with a third scenario that considers the likely situation in case PAC transfers were completely decoupled from production levels.

6. Main Results: CAP Reform and the Demand of Water Services

Using the MODERE Model to simulate the impact of Mid Term Revision of the Common Agricultural policy in the Campiña Baja Irrigation District, we can obtain the likely impact of the policy shock over the overall structure of the irrigated agriculture. Changes in the profitability of different crops lead to a reallocation of land and water among the different alternatives (see Figure 3). Olive trees area remain constant in the three scenarios, even when leaving the model freedom to modify planted area by 20% around baseline. The main reason for the stability of olive planted surface seems to be related with financial advantages with respect to other less predictable option Apart from olives the other competitive agricultural products in the district are cereals (mainly wheat and corn) and industrial crops (mainly sunflower, sugar beet and cotton), both of them supported by CAP subsidies.

The overall area dedicated to these competitive crops remains approximately constant in the three scenarios and water and land are reallocated among them. In the partial decoupling implemented by the Spanish government there is a land shift from cereals to industrial crops that can easily be interpreted as a consequence of a lower decoupling of subsidies for industrial crops giving this alternative a comparative advantage with respect to cereals. This situation is balanced when considering full, and symmetric, decoupling. Summing up, given that the region has a comparative advantage in producing cereals, industrial crops and olives, changes in financial incentives leave to a reallocation of land among the three crops categories.

Figure 3



The second important change is the two decoupling scenarios pulses, which profits become negative, disappears, and are replaced by green vegetables.

Comentario: Creo que LODE GREEN sobra.

As above said the access to water and irrigation facilities is an important factor that determines the financial viability of agriculture in Southern Spain, for this reason the reduction of incentives to cultivate, as implied by the CAP reform, does not lead to a reduction of the irrigated surface or by its substitution for rain feed agriculture. At least in the Campinha Baja Irrigation District, the CAP reform will not reduce the cultivated land or the activity of agriculture. This result might not be generalised as it depends on local conditions, including soil characteristics and agronomic vocation, production patterns and farmers attitudes towards income, risk and management. Effects may also differ depending on the time horizon and might be different in the short term, as considered in the case study, and the long term when the technologies, prices and the market environment may change.

Impacts of the CAP policy shock over the demand of water services are of the same nature. In our case there is not any significant effect on the amount of water demand required to put into practice crop decision in the decoupling scenarios. The quantity of water available for irrigation is an important constraint to which farmers respond by allocating the resource according to net margins, decision risk and decisions management. Water savings associated with decoupling are low and was estimated in 17 cubic hectometres in the partial decoupling scenario and only 6 in the full decoupling case. These variations are not significant and the right conclusion is that decoupling on its own will not have any significant effect on water demand. The reason behind this apparently discouraging result is that, provided there is enough water, in the current situation water prices are not determinant of the farmer’s decision. Water costs consists in fixed costs (irrespective on how water is used and what crops are planted) paid by hectare and the only variable costs that may be consider is the energy cost to apply water to crops depending the water source and the irrigation technique. This energy cost, the only one that may have real influence on crop decisions, is very low and has been estimated in 0.25 eurocents per cubic meter in the area.

Summing up, given that water variable cost is closed to zero and water availability is the critical factor to determine farmers profits, changes in subsidies and other price incentives will not have an effect on the amount of water used. Farmers will use all the available water to obtain the most beneficial land allocation among the different crops. Moreover, the reduction of CAP production linked subsidies is associated with a significant increase in the real productivity of water services as shown in Figure 4.

7. The Productivity of Water Services:

When water productivity is measured as the variable margin net of subsidies per unit of water used we observe a 20% increase whit respect to baseline in the full decoupling scenario. Water productivity of CAP supported products increase with decoupling from 0.15 to 0.18 euros per cubic meter and that of non CAP products increase from 2.21 to 2.28 euros per cubic meter, additionally the average water productivity increases due to the substitution of CAP for non CAP crops. Whit this kind of water productivity levels it is clear that a marginal water cost of only one quarter of a eurocent will not represent any incentive to save water.

Figure 4

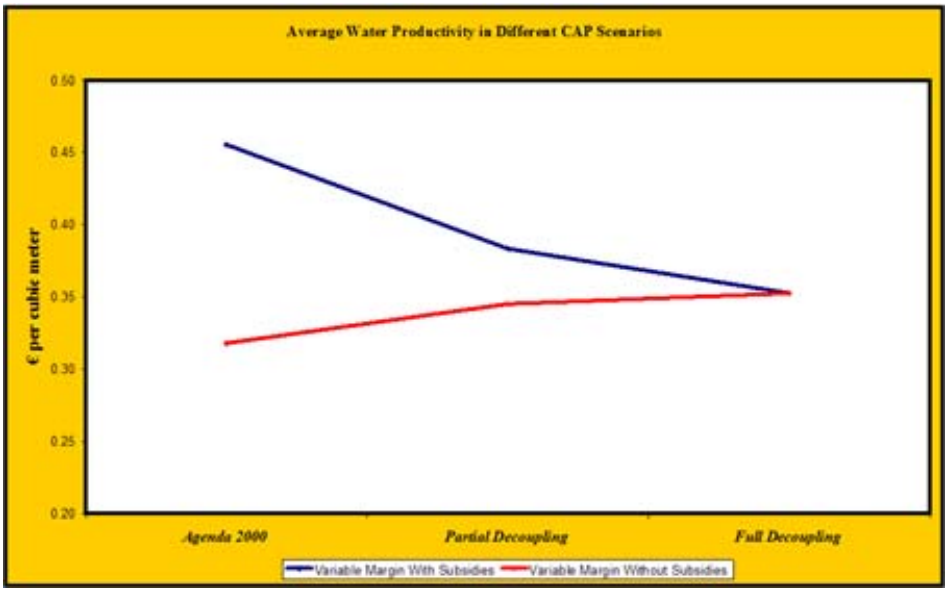
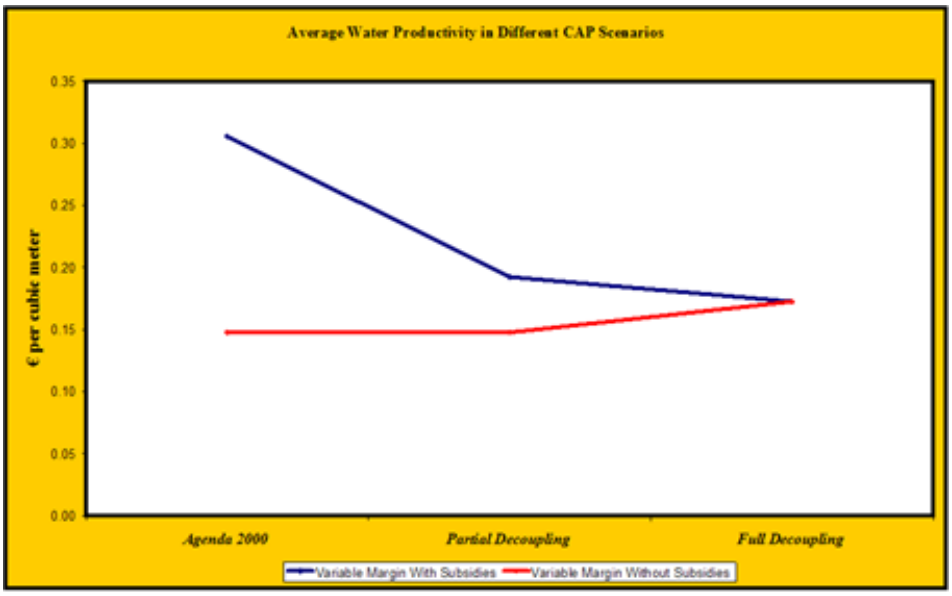


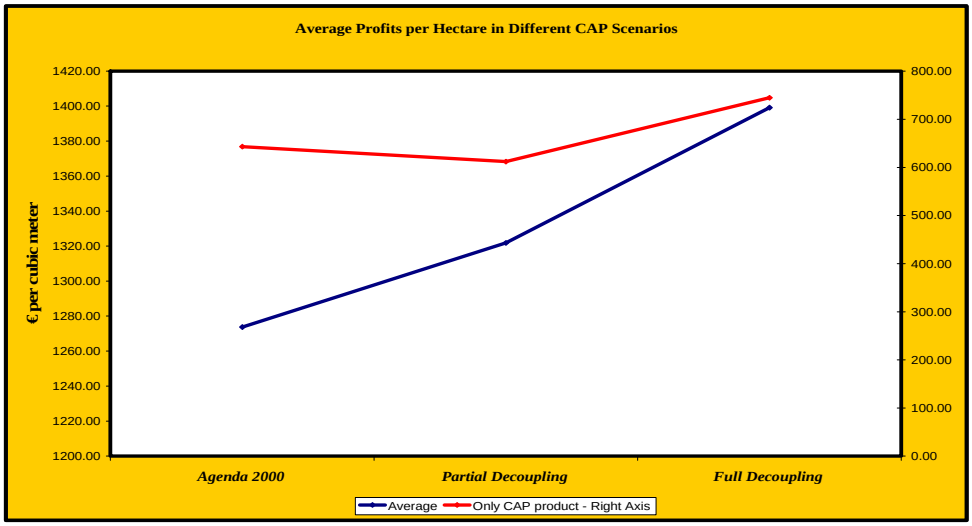
Figure 5



Water is not an exception. As market distortions from CAP subsidies are reduced market efficiency increases and input productivity is expected to rise. The average variable margin, interpreted as the producer surplus, considered without subsidies, as a measure of economic profits increases from an average of 1.260 € per hectare to 1.400 € per hectare, that is to say that land reallocation will allow farmers to increase their 'market' income in 140€ per hectare or around 700.000€ for the entire irrigation district.

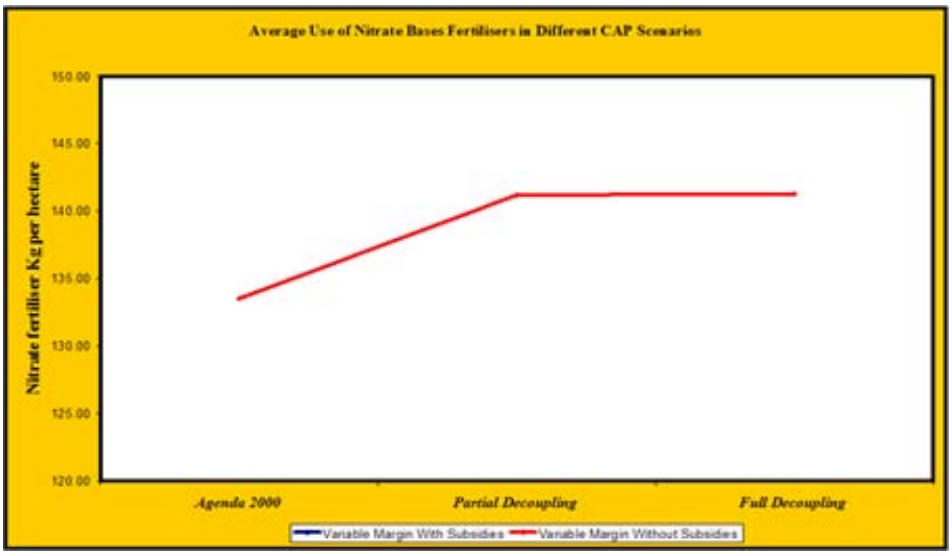
Considering that farmers will continue to receive PAC transfers efficiency enhancement associated with decoupling will mean a considerable improvement in land rents and rural households welfare. As shown in Figure 6, profits increases are also important in CAP supported products (see right axis).

Figure 6



One important negative impact of decoupling is associated with an increase in the use of fertilisers with a potential harming effect over surface and underground water. Average nitrate fertilisers use increase from 130 to 141 kilograms per hectare, and this increase is higher for PAC, from 140 to 150 kgs per hectare, than for fully commercial crops (from 105 to 107 kgs per hectare).

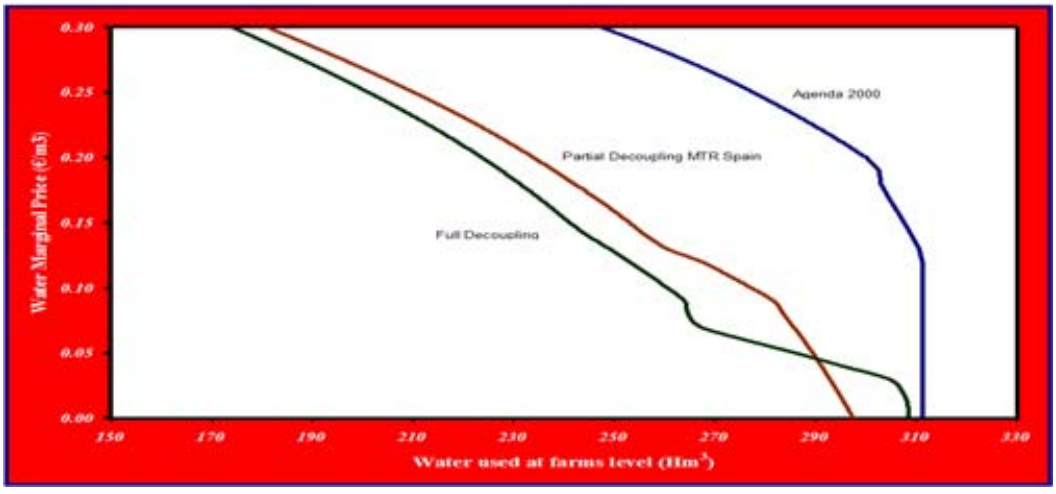
Figure 7



8. ¿How CAP subsidies decoupling will affect the effectiveness of water policy instruments?

Although the mid term CAP reform, and future advances in decoupling subsidies from production decisions will have a neutral effect on water use and a negative effect on the use of agro chemicals with potential negative effect on the quality of water sources, the new political framework of the European agriculture might open new opportunities for the WFD implementation. The most relevant change to be considered is that agriculture will now be more dependent on market incentives and prices. In the new context there will be the opportunity to use water prices as instruments for water saving and to improve the allocation of scarce resources among competing uses. The application of this kind of incentives is also facilitated by the separation introduced, between instruments designed to protect farmers income, as decoupled subsidies in the reformed CAP, and instruments designed to increase water efficiency and to internalise environmental and resource costs and improve cost recovery in the implementation process of the WFD. As far as income in guaranteed by lump sum transfers the Mid term CAP reform open the possibility to a water price reform without harming farmers welfare.This price reform would not only involve increases in water prices but also a conversion from an “area based payment system” to a volumetric pricing system.

Figure 8



In the Agenda 2000 Scenario farmers decisions are highly dependent of CAP financial support apart from other restrictions on quotas and production. This institutional constraints lead to a water demand function that is inelastic with respect to price variations, and the quantity of water demanded is only reduced when prices are well above the marginal productivity of water. In other words, in a productive region where cereals, olives and industrial crops are competitive and farmers receive an average subsidy of 16 eurocent per cubic meter of water used we can not expect that small increases in water prices will have a noticeable impact on water use decisions, even when the productivity of water in marginal products was of only one or two eurocents. When subsidies are linked to income but not to production decisions farmers will be more sensitive to water price changes and will have real incentives to allocate water to more valuable crops.

Figure 7 shows the results obtained by using the MODERE model to simulate the demand of water for different water prices. As can be seen the water price need to increase up to fifteen eurocents in order to induce a reduction of the overall quantity of demanded water. In the Agenda 2000 scenario price incentives will not be effective instruments to improve the ecological quality of water ecosystems and cost recovery increase and applications of the polluter pays principle will not be associated with savings in water use.

The willingness of farmers to respond to water price increases with decoupling as shown in figure seven and significant water savings can be obtained with prices as low as 2 eurocents. For intermediate water prices, for example of 0,10€ water demanded will be 20% lower in the partial decoupling scenario than in the baseline Agenda 2000 situation (that is to say, the agriculture in the irrigation district will demand 60 cubic hectometres less). With full decoupling water demand will be 30% lower (or 90 hectometres lower, than in the current situation (See Figure 7).

Although mid term revision of the CAP will not represent a reduction in water use in the Campiña Baja Irrigation District and the use of fertilisers will increase, the CAP reform represents an opportunity that enhance the effectiveness of price incentives as

instruments to improve the quality of water ecosystems, making possible the compliance with the WFD requirements and avoiding negative impacts on rural income.

References:

J. Berbel, (1989) Analysis of protected cropping: An application of multiobjective programming techniques to Spanish horticulture, *European Review of Agricultural Economics* 16:203-216.

J. Berbel, J. Gallego, H. Sagues, (1991) Marketing goals vs. business proÆtability: An interactive multiple criteria decision-making approach, *Agribusiness* 7 (6) 537-549.

J. Berbel, A. Rodriguez-Ocaña, (1998) An MCDM approach to production analysis: An application to irrigated farms in southern Spain, *European Journal of Operational Research* 107 (1) 108-118.

R.J. Delforce, J.B. Hardaker, (1985) An experiment in multiattribute utility theory, *Australian Journal of Agricultural Economics* 29 (3) 179-198.

T. Rehman, C. Romero, (1993) The application of the MCDM paradigm to the management of agricultural systems: Some basic considerations, *Agricultural Systems* 41 (3) 239-255.

G.C. Rausser, J. Yassour, (1981) Multiattribute utility analysis: The case of Filipino rice policy, *American Journal of Agricultural Economics* 63 (4) 484±494.

C. Romero, F. Amador, A. Barco, (1987) Multiple objectives in agricultural planning: A compromise programming application, *American Journal of Agricultural Economics* 69 (1) 78-86.

C. Romero, T. Rehman, (1984) Goal programming and multiple criteria decision-making in farm planning: An expository analysis, *Journal of Agricultural Economics* 35 (2) 177-190.

J.M. Sumpsi, F. Amador, C. Romero, (1996) On farmers' objectives: A multi-criteria approach, *European Journal of Operational Research* 96 64-71.