Annex 4: Case study for the water sector
'Environmentally Harmful Subsidies: Identification and Assessment'
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Commission, DG Environment

Task 2: Testing the OECD tools on case studies

1 IRRIGATION SUBSIDIES IN SPAIN (PISUERGA CHANNEL AREA)

Introduction to the case study

The authors acknowledge the complexity of irrigation water subsidies and emphasise that, for the purposes of this study, case studies aimed primarily to test the OECD tools' usefulness (quick scan, checklist and integrated assessment framework) and to allow a broad brush assessment of the potential environmental harm and the benefits of removal of a subsidy in the water sector. It is important to note that the economic data used in the present analysis build substantially on the literature available (see references). The case study focuses on information available for a specific irrigated area, the Community of irrigators of the Pisuerga Channel, in northern Spain. This is a relatively small area (about 10,000 ha) which can be regarded as fairly homogeneous. It should be noted that the Spanish territory is very heterogeneous in terms of climate conditions, water availability and agriculture practices. The water cost and tariffs applied also can vary substantially from region to region. Therefore economic estimates do not aim to represent the situation of the whole country. Nevertheless they offer insights that can be valid not only at local level, but also at regional and national level. When possible some general considerations have been made for the whole of Spain. Other considerations should be considered specific to the case of the Pisuerga Channel area only. Some lessons however could be drawn that are useful at EU level, especially in areas that, like Spain, suffer of relatively scarce water resources and relies on relatively low water prices for agriculture.

1.1 Testing the QUICK SCAN

1.1.1 *Linkage 1 - the impact of the support on the volume and composition of output in the economy*

1.	**Linkage 1 -** *the impact of the support on the volume and composition of output in the economy*. This identifies the link between the type of subsidy, its point of impact (input, output, profit or income), the price elasticity of demand and supply associated with the activity subsidised and ultimately the impacts on the levels of production and consumption. This in turn is what creates pressure on the environment. The following points are required to describe the linkage.	
1.1 Describe the type of subsidy	The subsidy is a support conditional on the purchase of a product. In this case the subsidy supports the purchase of an input to agriculture production: water for irrigation.	
	In Spain different water tariff systems are applied in different areas. Tariffs are applied on the basis of the size of the area irrigated (per hectare), on the basis of the volume of water used (per m^3), or on both (two-part tariff). The per hectare tariff is the most common, and is applied in 82 per cent of the irrigated areas; while the use of volumetric tariffs and two-part tariffs is quite limited (respectively 13 and 5 per cent of the irrigated territory) (Ministerio de Medio Ambiente, 2008a).	
	The fact that, in most cases, water pricing is based on area size rather than on the actual volume of water used, together with the application of relatively low water pricing in some areas, does not provide incentives to farmers to improve water use efficiency, and has historically lead to relatively high level of consumption.	
	These considerations also applies to the case of the Pisuerga Channel area, were water pricing is based on a fixed sum per unit of irrigated surface. The price there is relatively small (0.05€/m^3 in 2002) and it is considered to be insufficient to cover the full costs of water supply and externality costs.	
1.2 What is the point of impact (conditionality) of	The point of impact is on input use, specifically the access to natural resources (water) below opportunity costs. This in turn reduces the variable costs of	

the subsidy	production.
1.3 What are the intended recipients of the subsidy	The intended recipients are the finished product producers - i.e. farmers.
1.4 Size of the subsidy	The size of a subsidy for irrigation can be assessed as follow: Subsidy = (water value – water price to farmers) * yearly water consumption (m^3) for irrigation On the basis of data from Gómez-Limón and Riesgo (2003) and a study by Berbel and Gómez-Limón (1999) it is possible to assess the size of subsidies in the Pisuerga Channel area. **Water value.** The first step to asses the size of the subsidy for irrigation is to establish the full cost/value of water. According to the full-cost recovery principle, this should take into account production costs and externality costs. It should be noted that, while assessing financial costs can be relatively straightforward, externality costs can be difficult to estimate. In principle it could be argued that water pricing should cover *at least* the financial costs of supply (ie operating and capital costs). The Water Framework Directive (WFD) requires also that environmental costs are taken into account. In this case study we attempted to estimate both costs, on the basis of information and assumptions available from the literature. Gómez-Limón and Riesgo (2004) noted the difficulty to establish the real cost of irrigation water that should be used by each member state to implement the WFD. As far as Spain is concerned, only a few studies have been carried out to estimate such cost, giving results that range from 0.01 to 0.11 /m^3. This wide range of costs is due to the different levels of analysis (basin, smaller hydrological system or a single irrigated area) used for this purpose and the kinds of costs considered (see for example Massaruto, 2002). Gómez-Limón and Riesgo identified a number of possible irrigation water prices (higher than the current level), in particular: • A 'medium' price of 0.04 €/m^3 that would cover the financial costs of supply. • A 'Full Cost Recovery (FCR)' price of 0.06 €/m^3 which would be a tough application of full-cost-recovery principle, including a provision for environmental costs. In this analysis we refer to the medium price as a 'minimum' price level to cover at least financial costs, and the FCR price as an 'ideal' price if externalities were to be taken into consideration. **Water price to farmers.** The second step is to identify the water pricing applied to farmers for irrigation. According to Gómez-Limón and Riesgo, water pricing in the Duero Valley[1] in 2003 was based on a fixed sum per unit of irrigated surface. The water tariff was €60.59 /ha, equivalent to a volumetric tariff of 0.010 /m^3. **Water consumption.** The third step is to establish the average yearly consumption of water for irrigation purposes in Spain. According to Gómez-Limón and Riesgo (2003), the water consumption in the Pisuerga Channel was about 7000 m^3/ha/year, ie about 70M m^3/year. It should be noted that, if one were to assume that similar subsidies were applied in the whole of Spain, the overall water consumption for irrigation in the country should be assessed. According to the Spanish Ministry of Environment (2007) water consumption for irrigation in 2005 was about 16,500 Mm^3.

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[1] Community of Irrigators of the Pisuerga Channel, in the north of Spain

Subsidy:

Local level – the Pisuerga Channel area

Considering a water price of 0.04€/m^3 based on (financial) cost recovery, the size of water subsidy for irrigation in the Pisuerga Channel is 2.1 M€/year. Considering a water price of 0.06€/ha (FCR price) the subsidy is about €3.5/year. Table 1 below summarises the estimated size of subsidy for different price assumptions.

Table 1 Estimated amount of water subsidies for irrigation in the Community of Irrigators of the Pisuerga Channel

Water price	€/m^3	Consumption Mm^3	Price differential €	Subsidy €/year
Current price	0.01	70		
Medium price	0.04		0.03	2.1
FCR price	0.06		0.05	3.5

Source: Own calculations based on Gomez-Limon and Riesgo (2004)

National level – order of magnitude in Spain

As mentioned in the introduction, water tariffs change widely across Spain hence it may be a too strong assumption to consider the Pisuerga Channel area as representative of the whole country. However, the price scenarios used by Gómez-Limón and Riesgo (2003) can be compared to the average irrigation water prices in Spain and some considerations can be made regarding at least the order of magnitude of subsidies in the country.

In order to broadly estimate the size of irrigation subsidies for the whole country, we looked at the average payment for irrigation water services (surface and underground water) in Spain as estimated by the Spanish Ministry of the Environment (2007b), which is about 0.05 €/m^3.[2] The price is above the water price in the Pisuerga Channel and also above the financial cost recovery estimated by Gómez-Limón and Riesgo (2004). No estimate was found on the actual financial cost of water for the whole Spain, nor for full cost recovery estimates. Hence the FCR price used for the Pisuerga Channel has been used as a lower bound to estimate the level of subsidy in the whole country. This is meant to provide an order of magnitude rather than an exact size of the subsidy, and should be taken as a minimum value.

Water consumption for irrigation in 2005 was about 16,500 millions m^3.[3] Recalculating the subsidy using the FCR price of 0.06 €/m^3 as a benchmark for full cost recovery, the amount of subsidy in the whole Spain would be about 165 M€/year (see Table 3). Again, given the difficulty of estimating the real externality costs of water, and the differences across water pricing in the country, this is not meant to be an exact value, but rather to given an order of magnitude of the size of water subsidies in Spain.

Table 2 Estimated amount of water subsidies for irrigation in Spain – Ministry of Environment average price

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[2] Ministerio de Medio Ambiente (Ministry of Environment). 2007. Precios y costes de los Servicios del Agua en España - Informe integrado de recuperación de costes de los servicios de agua en España. Artículo 5 y anejo III de la Directiva Marco de Agua

[3] Ministerio de Medio Ambiente (Ministry of Environment). 2007. Perfil Ambiental de España 2007. Informe basado en indicadores.

[4] Gómez-Limón, J.A. and Riesgo, L. 2004. Irrigation water pricing: differential impacts on irrigated farms. Agricultural Economics 31 (2004) 47–66

Water price		Consumption (2007)	Price differential	Subsidy
	€/m³	M m³	€	M €
Current price	0.05	16,500		
FCR price	0.06		0.01	165

Source: own calculation based on Gómez-Limón and Riesgo (2004)[4] and Ministerio de Medio Ambiente (2007)[3]

1.5. Description of the sector	**Agriculture:** Irrigated agriculture contributes to 2 percent on the Spanish GDP and employs 4 per cent of the population. (Ministry of Environment, 2007). According to official 1997 data, productivity of irrigated land was 339 000 PTAs/ha, against 48 000 PTAs/ ha of non-irrigated land, i.e. a 700 per cent average improvement in productivity when water is available (Berbel and Gomez-Limon, 1999) (respectively €2,040 and €290 - in 1999 terms). Irrigated agriculture also sustains the agribusiness industry (canning, frozen vegetables, export horticulture, etc.).

In 2006, irrigated agriculture in Spain was responsible for 50 per cent of agricultural production, covering about 13.2 per cent of the cultivated area (about 3.3 M ha) and consuming between 70-80 per cent of total water supply (Ministry of Environment, undated).

Table 3: Agriculture and irrigated area size in Spain

Year	Utilised agricultural areas (UUA) (ha)	Irrigated land (ha)	Irrigated area compared to UUA (%)
2002	25,254,678	3,316,682	13.1%
2003	25,029,424	3,335,540	13.3%
2004	24,942,736	3,354,416	13.4%
2005	24,973,015	3,396,601	13.6%
2006	25,096,200	3,319,790	13.2%

Source: Ministry of the Environment, undated

About 30 per cent of water infrastructures is more than 100 years old. Losses in the distribution systems are substantial, and the introduction of new technologies is very difficult (Berbel and Gomez-Limon, 1999). Although irrigation techniques have been improving in recent years, inefficient techniques are still relatively wide spread (see table below).

Table 4: Overview of types of irrigation and irrigated crop patterns in Spain

Technology	Water source	Timing	Crop types
69% gravity (furrows and flooding) – widespread in many areas, traditional 24% sprinklers, especially in plateau/inland areas 17% drip irrigation, especially in Mediterranean coastal areas	71% surface 28% aquifers 1% return flows <1% purified <1% desalinised seawater	Generally permanent or support in most regions. Where there is enough rainwater, irrigation is temporary, e.g. in Cantabria and Asturias	Continental areas: maize, beet, cereals Mediterranean areas: citrus, horticulture, rice South: maize, tobacco, rice, horticulture, olives, fruit

Source: Ecologic 2007

The Pisuerga channel area: this irrigated area covers about 10,000 ha, on which about 1000 irrigators are farming. In 2000 the main crops cultivated were winter cereals (50.6 per cent), alfalfa (17.6 per cent) sugar beet (16.2 per cent), maize (8.3 per cent), sunflower (2.5 per cent) and other minor crops (4.7 per cent). The official water allocation (maximum level of water available to farmers) was 8,100 m³/ha/year, but on average only 7,000 m³ /ha was consumed. The most widely system of irrigation used is gravity irrigation. Sprinkler irrigation is used only for

	sugar beet and alfalfa. **Water management:** Water management responsibilities in Spain are divided between different levels of government: River Basin Authorities (Confederaciones Hidrográficas) that depend of the central government's Ministry of the Environment for the management of shared river basins; Water Management Agencies (Agencias del Agua) that depend of autonomous regional governments for river basins that are entirely within one autonomous region; autonomous regional governments for the management of protected natural areas; local governments in issues pertaining to public water supply; and irrigator associations (Confederaciones de regantes) for management and distribution of irrigation water among their members (Hernández-Mora et al, 2007). The 'Confereraciones de regantes' are farmers' associations, which distribute water to the individual members of the irrigation units. There are different typologies of associations, depending on the type of rights attributed to the water users (Ministerio de Medio Ambiente 2008b): • Traditional 'comunidad de regantes': these associations own all the irrigation installations, including the main canals • State Plans 'Comunidad de regantes' (nuevos regadios): the main reservoirs and canals are built, maintained and exploited by the government, while the associations of irrigators manage the secondary canals and other irrigation infrastructures • Entities which only use underground water: associations of irrigators whose common objective is the common exploitations of a well or group of wells. They typically pay for all drilling, installation, operation and maintenance cost
1.6. Price elasticity of demand and supply of the input and output markets	A number of studies (Varela-Ortega et al. (1998), Gómez-Limón and Berbel (2000) and Feijoó et al. (2000)) indicate that water pricing may not stimulate reduced water consumption, due to the low elasticity of demand for irrigation water. Elasticity, however, tend to vary according to local conditions. Berbel and Gómez-Limón (2000) analysed the elasticity of demand in three irrigation units, which were considered a representative sample of Spanish irrigated agriculture: • Comunidad de Regantes Bembezar (Sevilla) • Comunidad de Regantes Fuente Palmera (Cordoba) • Comunidad de Regantes Bajo Carrión (Palencia) For each area the authors identified specific demand curves, which depend upon the local conditions of climate, soil and technical environment. Each demand curve was in turn divided into three segments according to how elastic the quantity of water demanded is to changes in water price: • Segment A (inelastic): the farmer makes a very small or zero response to small price increases. Existing crop distribution and water demand remain the same. • Segment B (elastic): at further price increases the farmer responds to price by reducing water consumption. Some water intensive crops are substituted by crops that consume less water and/or non-irrigated crops. • Segment C (non-efficient): at very high price increases demand is again inelastic, and there is no significant change in terms of crops and water consumption. Figure 1: Irrigation water demand

Bembezar

The water price ranges corresponding to each demand segment are shown below:

Tab 5: Demand segment (€/m^3)*

Segment	Bembezar	Fuente Palmera	Bajo Carrión
A (small price increase - inelastic)	0-0.08 €/m^3	0-0.04 €/m^3	0-0.06 €/m^3
B (medium price increase - elastic)	0.08-0.16 €/m^3	0.04-0.16 €/m^3	1.07-0.11 €/m^3
C (high price increase - inelastic)	> 0.16 €/m^3	> 0.16 €/m^3	> 0.11 €/m^3

Conversion rate 2000: 1 ESP = 0.00601 €

In terms of crop plan, segment A is characterized by crops with high water consumption (cotton, corn, sugar beet).
As the price of water increases, i.e. moving towards segment B, corn is replaced by winter cereals (wheat, etc.) and sunflowers.
Segment C is characterized by the use of water almost exclusively for horticultural crops (onions, potatoes) with the rest of the land growing non-irrigated field crops (dry cereals and sunflower).
See table below for details on each irrigated area.

Table 6: Crop plan by demand segments

Segment	Bembezar	Fuente Palmera	Bajo Carrión
A	Cotton, corn, sugar beet and vegetables	Cotton, sugar beet and vegetables	Cotton, sugar beet and alfalfa; winter cereals
B	Cotton and corn reduced; sunflowers and wheat increase	Cotton and sugar beet decrease; sunflowers and wheat increase	Corn and alfalfa disappear; cereals increase; sunflowers, sugar beet
C	Wheat and sunflowers not irrigated; vegetables	Wheat and sunflowers not irrigated; vegetables	Sugar beet decreases; winter cereals and sunflowers increase

In terms of economic impacts, the authors highlight that higher water pricing can result in a significant reduction in farmers' income, depending on the elasticity level (see table below).

The fall in income is more severe in segment A (small change, inelastic demand), with a reduction ranging from 25 per cent (CR Fuente Palmera) to 40 per cent (the two other areas). Crop composition and water demand is more or less the maintained until the price reaches about €0.05-0.09/m^3 (depending on the area). This implies that farm income will fall significantly before water consumption is affected.

In segment B substitutions and variations in crop plans take place as adaptations

	to further rises in the price of water. Falls in farm income are primarily due to the substitution of more profitable water-demanding crops with other crops. In segment C water prices rise beyond the economic viability of the agricultural systems. This is not efficient from a political and economic point of view as water demand is relatively inelastic, i.e. it does not respond to further price increases, while public-sector revenues fall as the system cannot adapt to this price level. In general it can be noted that, while water elasticity tends to be relatively low, it varies across areas (e.g. depending on the technology used and crop alternatives available) and it is related to the price range considered. It will be important to identify the areas and conditions where consumption will be more sensitive to price (i.e. where elasticity is higher) so that a small decrease in farmers' income can lead to higher decreases in water consumption - in order to minimise the impacts of a subsidy reform on income and ensure effectiveness. It is also important to note that elasticity of water demand may change over time. In particular, it is usually considered that that price elasticity of water tends to be inelastic in the short-term but becomes more elastic over time. The scope and extent of this case study did not allow to investigate the inter-temporal effects of elasticities in detail, but we recommend that, if further initiatives on water irrigation subsidy removal were to be taken, this issue is taken into consideration.

1.1.2   *Linkage 2 – The mitigating effect of environmental policies in place*

2 Linkage 2 – *The mitigating effect of environmental policies in place* – which takes into consideration policies and emission abatement techniques. Linkage 2 measures the emissions or environmental impacts that result from a volume of activity excluding those 'filtered' by environmental policies. **Note:** Because of the complexity and data requirement difficulties associated with establishing linkages 2 and 3 here just draw qualitative conclusions or quantitative only where possible.	
2.1 Are there any environmental policies in place or emission abatement techniques which mitigate the impacts of the support	In the early 1990s the **Water Management Regime (Water Abstraction Plan)** was launched in the Upper Guadiana basin to recover the over-drafted aquifer. It restricted water extractions and re-defined the previously established water allotment rights of the private irrigators by reducing substantially their entitled water assignments. The compulsory program established different annual maximum levels of water consumption depending on farm size. Larger farms had the highest water limitations. Farmers were not granted any compensation payment for their derived income loss and, hence, the social burden of the policy was supported directly by them. Due to the low success of the programme, the **Special Plan for the Upper Guadiana** (SPUG, CHG, 2007) was enacted. The policy aimed to promote environmental sustainability through the elimination of groundwater overdrafts and to maintain the rural and agrarian socio-economic structure by launching special complementary rural development programs (Varela-Ortega et al., 2007:1-2). Now there is a **licensing system**. Licenses are conditioned to water availability and there is a hierarchy of uses (urban, irrigation, industry). There can be modification of licenses – water per hectare, litres per person- without compensation. There is no seniority but some licenses can only be used when water is available. In practice, it functions like 'water shares' in multifunctional infrastructures. It establishes the rules for management of dams and aquifers and penalises inefficient water use and/or incentivises efficient use. The system allows for prosecution and establishes fines for illegal use. It provides for substitution of waters (dams vs waste water for example) and includes some compensation to farmers. Therefore, in Spain since 1999 there is limited **water trading** (Law 46/1999).Although not an environmental policy *per se* (as water trading main aim is to allocate water between users), the measure was also

	meant to deal with overallocated water, reduced availability, growth pressures and also to address new environmental objectives. Initially (1999) the water trading system aimed at dealing with drought shortages (1991-95 drought) by introducing flexibility in the license system. Between 2005-2007 new goals were established, namely to deal with structural scarcity (overexploitation), contribute to environmental objectives (environmental flow/aquifer balance) and provide licenses to Regional Governments (states) for socio-economic objectives.

Drip irrigation technologies have been subsidised in the region of Valencia and the Guadalquivir river basin. These were expected to bring reductions in water demand for irrigation and 'product output/fertilizer pressure' ratio (as fertilizers are provided through irrigation water), reducing losses (García Mollá, 2002, and Berbel, 2005, as in Berbel et al, 2007: 10, 18).

Since 2001, 95 per cent of the budget devoted to irrigation in Spain has been targeted to finance **modernisation projects.** These have reached 1.3 M ha and a budget of €4 billion (Barbero, 2005, as in Berbel et al, 2007: 14). Such investment intended to ensure proper conservation of irrigation districts raising the efficiency of poorly maintained water structures dating back to before 1960. Private and public gains were expected in the form of more efficient and productive districts as well as water conservation and reduced pollution, respectively. Beneficiary farmers had only to pay for 50 per cent of the project cost and were granted preferential loans to meet their obligations. However, even water prices set at full cost recovery have not been sufficient to finance the projects, as irrigation systems are very old. Furthermore, projects have become increasingly costly as they have been re-focused to include environmental, structural, technological and land planning/tenancy components. Nevertheless, such projects have been praised and uncontested (Berbel, et al 2007)

Another policy able to mitigate the impact of subsidies is the **cross-compliance policy of the CAP**, which incentivises farmers to achieve 'Good Agricultural and Environmental Conditions' in their parcel, and comply with several European Directives, five of which relate to the environment (the Wild Birds Directive, the Groundwater Directive, the Sewage Sludge Directive, the Nitrates Directive and the Habitats Directive) (Council Regulation 1782/2003).. |
| 2.2 What are the impacts of the environmental policies in place? - i.e. on emissions or environmental impacts that result from a volume of activity. | The impact is low (in some cases negative, namely regarding subsidisation of **drip irrigation** technologies in the region of Valencia) (see 2.1. above). Some mitigation measures have been adopted over time to mitigate the impacts of the support, namely to reduce water use and the pollution associated to such use. However, the results thereof have not been very positive.

Regarding the **Water Management Regime,** authorities were not able to fully develop and implement the water use limitation policy. High enforcement costs led to a limited uptake of the policy and to the continuation of excessive water mining above legally permitted levels. Since the prevailing institutional framework of the Upper Guadiana basin did not induce more efficient water management practices, the **Special Plan for the Upper Guadiana** (SPUG, CHG, 2007) was enacted.

The results obtained with **water trading** were both positive and negative. Among the first there were positive economic effects (it benefited the sellers and the high profit irrigation areas of the Mediterranean). The system has contributed to public goals on insuring water supplies (guarantee) and the environment. Some of the sellers have used funding to improve technical efficiency of irrigation distribution networks. The environmental authorities, however, have not detected environmental impacts of reduced flows. Among the negative results were the limited number of transactions (due to publicity, legal issues and infrastructures limitations). Monopoly of supply led to higher prices (abusive prices due to lack of competition and information). There was |

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<td>opposition of regional authorities because of economic impacts in deprived areas – the point of irrigation development. There has been low regulation of the process regarding prices and control, being necessary to reinforce regulation (control) and transparency. In some areas the overall effect has been negligible. Even with some trading of water, in south-eastern Spain water cost is only around 2 per cent of total cultivation costs (Berbel et al, 2007: 4).

The subsidisation of **drip irrigation** technologies in the region of Valencia and the Guadalquivir river basin did not reduce consumption rates. It rather encouraged the planting of new crops, such as orchards and vegetables, that are more water-demanding than the previous ones. Therefore, negative effects resulted from the fact that changes in technology induced new crop patterns and increased total water consumption (García Mollá, 2002, and Berbel, 2005, both as in Berbel et al , 2007: 10, 18).

In the past, **CAP** subsidies heavily oriented towards water intensive crops (e.g., sugarbeet, cotton and cereals) and assigned according to production levels have stimulated the adoption of irrigation practices (Sumpsi et al., 1998, Gomez-Limón et al, 2002, Arriaza et al., 2003, Iglesias et al., 2004, as in Berbel et al 2007: 13). This was particularly evident in the case of cotton. Farmers' use of water was driven by subsidies, as higher compensatory payments were given to irrigate acreage than to non-irrigated acreage (Rainelli and Vermersch, 1998, and Dubois de la Sablonière, 1997, as in Berbel et al, 2007: 13). With 'cross-compliance' the economics of irrigation is due to become more guided by the relative productivity of crops and water accessibility than by relative farm subsidies granted to the crops, since it is less likely that water intensive cultures will keep on being promoted through CAP subsidies. According to projections based on actual data regarding the effects of cross compliance on water consumption in Spain (Ministerio del Ambiente, 2008), there is a slight reduction of 23.000 ha in irrigated area when compared to Agenda 2000. This should represent a reduction of 156 hm^3 in total water use and 8,277 m^3 in use per hectare. In terms of crop selection, there are different levels of change depending on the region. The effects of the new CAP rules on water demand in Spain are due to be important in continental areas (growing non-Mediterranean crops), which are those mostly affected by the change in agricultural support since the choice of crops in these areas has historically been influenced by the subsidies provided. Effects instead are expected to be less relevant in areas where fruits and vegetables are the primary irrigated crops, since these cultivations provide high profits to farmers (even when subsidies are not provided).</td>
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1.1.3 *Linkage 3 - the assimilative capacity of the affected environment*

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<td colspan="2">Linkage 3 - *the assimilative capacity of the affected environment* – which represents the dose response relationship taking into account the assimilative capacity of the environment. This might be a highly site specific factor, particularly when the emissions have predominantly local or regional effects, therefore evaluated through dedicated studies. However, in the case of pollutants that have global effects (like CO_2 emissions or CFCs) effects are not site specific and general conclusions can be drawn.</td>
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<td>3.1. First, could you describe what the size of the environmental damage is? Where possible could you quantify? Otherwise, describe qualitatively.</td>
<td>Subsidised water price has an impact on the amount of water extracted/used for irrigation, as arguably a low price does not encourage efficient use. This in turn can lead to wastage, groundwater depletion, pollution, soil salination and biodiversity loss.

High environmental harmfulness is expected to worsen as a consequence to increased water scarcity, which is also affected by climate change and related extreme natural hazards (drought, desertification). This is expected to be particularly an issue in Southern Europe – were water stress is higher.

For the purpose of this study we analyse two key impacts of irrigation subsidies: water consumption and fertiliser use. In general, it should be noted that the environmental impacts of increased water abstraction will have both a spatial and</td>
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temporal dimension. Although this analysis focuses mainly on the spatial effects, it is important to take into consideration that the short term and long term effects of water overuse may differ. In particular, it is expected that in the medium-long term, with increased water stress – due to climate change and the cumulative effect of overexploitation - the future impact of irrigation subsidies on the environment will worsen. These consideration should be taken into account when evaluating (and communicating the reasons for) subsidy reform.

Water consumption

To establish the level of water abstraction attributable to water subsidies, it is necessary to calculate the difference between current (subsidised) consumption and hypothetical consumption if the price were not subsidised.

Gómez-Limón and Riesgo (2004) estimated water consumption levels in the Duero Valley region according to different water prices (same as in section 1.4: a 'medium' price of 0.04 €/m^3; and a 'Full Cost Recovery (FCR)' price of 0.06 €/m^3). The current (2002) price of water in the area was considered to be €0.01/m^3.

Water consumption also takes into account the behaviour of different typologies of farmers, grouped into 3 clusters:

- *Cluster 1*: commercial farmers. Their main aim is to maximise profit. They usually grow the most lucrative but 'risky' crops (in terms of profit variability), such as alfalfa, sugar beet and maize. They farm about 34.5 per cent of the area under study
- *Cluster 2*: large conservative farmers. They are more averse to risk. They usually cultivate less profitable but less risky crops, ensuring more stable income – e.g. cereals. They farm the largest share of the irrigated area under study (51.9 per cent)
- *Cluster 3*: part time conservative farmers. They are similar to cluster 2, but not exclusively engaged in agriculture. The most common crops are typically cereals and alfalfa). They represent the smallest proportion of the irrigated area under study (13.7 per cent)

Water consumption reductions due to an increase in water price are summarised in the table below, for each cluster. Reductions in water consumption as a percentage of current demand for water is shown in parentheses.

Table 7: Water consumption reductions (m^3/ha)

	Current (subsidised) price 0.01 €/m^3	Medium price 0.04 €/m^3	FCR price 0.06 €/m^3
Cluster 1	8,105	- 1,896 (-23.4%)	- 3,504 (-43.2%)
Cluster 2	5,360	- 3,752 (-70%)	- 3,965 (-74%)
Cluster 3	3,659	- 2,227 (-47.8%)	- 3,082 (-66.2%)

Source: Gómez-Limón and Riesgo (2004)

In the Pisuerga Channel, a price of 0.04 €/m^3 would lead to a decrease of water consumption between 23 and 70 per cent compared to the current subsidised price of 0.01 €/m3. A price of 0.06 €/m^3 would lead to a decrease between 43 and 74 per cent. This would be due to a change in crops (from more to less water intensive) rather than in irrigation technology.

Fertilizer use

Water-demanding crops such as maize and sugar beet have typically higher fertilizer requirements than crops with lower irrigation needs (e.g. irrigated winter cereals), and much more than rain-fed crops.

As lower water price stimulates the farming of crops with higher irrigation needs, it

arguably leads also to higher fertilizer consumption. The share of fertilizers attributable to water subsidies can be assessed by comparing the current level of fertilizers use with hypothetical use (due to crop changes) at higher water prices.

According to the example above by Gómez-Limón and Riesgo (2004), fertilizer use will decrease with higher water prices, depending on farmers typologies (clusters) – see above for definitions. The table below summarises the decrease in fertilizer use per cluster at (higher) subsidised price, medium price and FCR price.

Tab 8: Changes consumption of nitrogen fertilizers (Nitorgen Fertilizer Unit /ha)

	Current subsidised price 0.01 €/m^3	Medium price 0.04 €/m^3	FCR price 0.06 €/m^3
Cluster 1	68.7	- 24 (-34.8%)	- 22 (-32.3%)
Cluster 2	120.7	- 56 (-46.5%)	- 61 (-50.2%)
Cluster 3	38.6	- 7 (-18.4%)	- 8 (-19.6%)

Source: Gómez-Limón and Riesgo (2004)

From the analysis of the Pisuerga Channel it can be inferred that the hypothetical fertilizer use at 0.04 €/m3 would be 18-46 per cent lower that at the current subsidised price of 0.01 €/m3. At a price of 0.06 €/m3 fertilizer use would be reduced by 20-50 per cent..

3.2. Could you provide insights on the assimilative capacity of the environment to these impacts?	The level of water scarcity and overexploitation will depend on local conditions, i.e. on the quantity of water available and climatic/geographic conditions. Nitrogen assimilative capacity, as a consequence of the increased use of fertilizer, will also depend on local characteristics.

Summary of the results of the application of the quick scan to the case study	
1 Is the support likely to have a negative impact on the environment?	Impact on the amount of water extracted/used for irrigation, as arguably a low price does not encourage efficient use. This in turn can lead to wastage, groundwater depletion, pollution, soil salination and biodiversity loss – likely worsened by climate change
2 Does the support succeed in transferring income to the intended recipient?	Yes Note: This question seems more related to the impact assessment (1.3) – the quick scan only asks 'who' are the recipients, while effectiveness is dealt in IA
3 Is the support worthy of further scrutiny to assess whether their reform/removal would benefit the environment?	Yes. It clearly has environmental impacts worth being explored. Also, it provides substantial support to the sector. Its removal can have significant environmental and economic effects
4 What are the impacts on the subsidy on trade? Are they important? How likely it is that if you remove a subsidy in country X, it will have any global environmental impacts?	The subsidy affects 'virtual water'. Usually water-intensive products are imported to areas where the price of water is very high, which in turn exports products which do not require so much water (Velázquez, 2006). In this case, subsidies tend to distort this flux, as water intensive products are produced at rather competitive cost in water poor areas, given the low price of water. By removing the subsidy the production cost of water intensive crops might rise significantly in water scarce areas. This would potentially lead to a change in production patterns in Spain, likely affecting the import and export of agriculture produce. However, caution is required since water in water scarce areas is typically used more efficiently and more productively and tends to be more expensive than in other areas. The value added of farming in these areas (mainly horticulture and flowers in green houses and also fruit trees) is high - e.g., the net margin between rain-fed agriculture and irrigated agriculture is 0,44EUR/m^3 for non-citrus fruit and 0,35EUR/m^3 for citrus fruit (Ministry of Environment, 2008). Until a very high water price is reached, the elimination of subsidies to water infrastructures

		might not change their decisions on crops (and hence water use), since the price of the input (i.e. the water cost for the producer) is a very small proportion of the total costs (and benefits) of production. Also, there is no alternative best crop that will generate at least the same benefits.

Some additional questions on the use of the quick scan

The OECD 2005 (p.35) criticises the quick scan method, as not so easy to apply method. In particular, the linkages portrayed by quick scan model can be assessed only thought the use of general equilibrium models. The technical and resource constraints of policy makers makes it not always possible to use such models and is 'generally necessary to adopt a more pragmatic and simplified approach

1.	Based on the application of the tool to your case study, do you think it possible to use the quick scan and produce credible results without employing a general equilibrium model and environmental impact evaluation techniques?	Yes, if information available from existing studies (which may not always be the case, however). It should be noted that, if time/budget are limited, the analysis may have to rely on secondary data (such as in the case of this case study). However, for a more comprehensive assessment of the subsidy, some primary data may be needed, and/or the reliability of secondary data may have to be assessed, especially when these are relatively old (e.g. over 10 years old). This may be time consuming and can make the approach more cumbersome, even when equilibrium models are not required.

1.2 Testing the CHECKLIST

1.2.1 *Step 1 – Does the policy filter effectively limits environmental damage?*

Is there an environmental policy filter (e.g. size of tradable quota after subsidy removal; level of standards; production limits; rates of environmental taxation; demand and supply elasticities of taxed item etc) which mitigates the effects of a subsidy in the environment? If effective, the removal of the subsidies will bring no or little benefit. **Note this section could usefully build on the information collected for analysing linkage 2 in the quick scan.**

1.	Describe the environmental policy filter	**Water Management Regime (Water Abstraction Plan).** This aimed to promote environmental sustainability through the elimination of groundwater overdrafts and maintain the rural and agrarian socio-economic structure by launching special complementary rural development programs; **Subsidisation of drip irrigation** technologies in the region of Valencia and the Guadalquivir river basin. This was expected to bring reductions in water demand for irrigation and 'product output/fertilizer pressure' ratio. 95 per cent of the budget devoted to irrigation in Spain is targeted to finance **modernization projects** - i.e.1.3Mha and a budget of € 4 billion (Barbero, 2005, as in Berbel et al, 2007: 14). Such investment intended to ensure proper conservation of irrigation districts raising the efficiency of poorly maintained old water structures. The **cross-compliance policy of the CAP** conditions payment to the farmers achieving 'Good Agricultural and Environmental Conditions' in their parcels
2.	What restrictions to production, pollution or resource depletion levels result from the policy filter?	Low. Farmers are often more governed by subsidies than by land capabilities (Ambrosio Flores et al., 2008, apud Martínez-Casasnovas et al, 2008). See quickscan point 2.1 and 2.2 for details
3.	What will happen to the policy filter once the subsidies are removed? See example on p.90 OECD 2005.	Unless there is a political decision in that direction, they are expected to stay in place.

4. In the light of the above answers, is the policy filter effective in mitigating the environmental impacts caused by the subsidy? YES - the policy filter is effective in limiting environmental damage. Then the subsidy's removal is not likely to have significant environmental benefits. The use of the checklist ends here. NO - if the policy filter is found to be not effective in limiting environmental damage, then you should move to step 2. Please justify your answer.	NO – as they have minimum or no effect on water consumption. In some cases they even lead to increased farming of water intensive crops.

1.2.2 *Step 2 - More benign alternatives are available now or emerging*

Availability of more benign technological alternatives (present or emerging) - comparison of the environmental profile of the subsidised product and probable ones) and how the environmental profile of these and modes of production compare to the previously subsidised ones. It should be noted that, at least for the long term availability, this might require some judgement from the analyst (Pieters, 2003).

1. Are there technologies and products likely to replace the previously subsidised products and modes of production? • Please note: consider not only domestic technologies/ products but also products/technologies available abroad.	**More efficient and targeted irrigation systems** (e.g. drip irrigation) and monitoring of water use would increase water saving as well as lead to lower water bills for farmers. The sole investment in irrigation technologies without quantitative controls, however, can lead to different results, e.g. by encouraging the planting of more water intensive crops. **Programmes that stimulate the planting of crops more suited to the low level of water available** in the region will also be helpful Compulsory **water use practices** in the code of Good Practices of the Rural Development Plan (RDP) and the cross-compliance scheme of the CAP can also contribute to water saving.
2. How do the environmental profiles of these competing products and modes of production compare with those of the previously subsidised ones?	Positive. Drip irrigation systems are associated to less waste of water and pollution by fertilizers, since water is directly applied in the water used. However, it is crucial that alternative measures and policies are backed by adequate monitoring, and that the adoption of less water-intensive crops is sufficiently stimulated.
3. Is the implementation of these alternatives hampered by the subsidy under scrutiny? • Highlight here if the subsidy has an impact on trade of more benign technologies coming from third countries. If yes, specify what impacts and how important these are.	Low water prices provide low incentive to investment in new production processes and technologies from an economic perspective and bias crop selection. No relevant impact.
4. What is the likelihood of these technologies and products to replace the previously subsidised ones?	High if there is an active policy in such direction acting on institutional arrangement of districts and the type of pricing scheme (volumetric rates rather than flat rates/per hectare charges, increase of cost recovery rates to cover full cost).

	Adoption of water conservation technologies and practices in some cases may depend largely on structural factors, agronomic conditions and financial constraints, and to a lesser extent on water prices. This is evident in very productive and innovative regions, such as Valencia. In fertile regions where high value added crops are grown, water prices represent a very small proportion of the production costs and farmers choose the different technological sets (defined by a combination of crop and production technique) as a response to the changes in factors such as product prices, cost of labour services, crop yields, product quality characteristics and financial conditions. On the other hand, in old water districts of less productive regions, with high water allotments and limited crop diversification, technical change does not appear and farmers adopt water conservation technologies as a response to an increase in water prices (e.g., changing from flood to sprinkler irrigation and improving water management and application). Varela-Ortega, 1998: 201-2
In the light of the above, are there more benign alternatives available now or emerging (YES/NO)?	YES.

1.2.3 *Step 3 - Does subsidy conditionality lead to higher production?*

Some items under step 3 require the use of general equilibrium models. However the use of such models is beyond the purpose of the checklist. The aim of this point should be to detect whether more detailed analysis is required to understand the wider consequences of subsidy removal - **note that this step can usefully build on information gathered for Linkage 1 in the quick scan**:	
1. Does the subsidy conditionality (i.e. the point of impact of the subsidy – output, input, income or profit, see Linkage 1 of the OECD quick scan) lead to higher production? In order to understand this, the following characteristics of the subsidy need to be understood :	See quick scan
o the size of subsidy:	See quick scan
o elasticities of supply and demand:	See quick scan
o duration of subsidy (e.g. when were they introduced and do they have a sunset clause?):	Water pricing has usually been below full cost recovery (especially if externality costs are taken into account) - with the exception of some regions, which have recently introduced more effective pricing. There is no sunset clause. However, the Water Framework Directive requires Member States to adopt water pricing by 2010, taking into account 'the principle of recovery of the cost of water services, including environmental and resource costs' (art. 9). How prices will adapt to the WFD Directive requirements remain to be seen.
o conditionality (e.g. output, income, profits or income? On the importance of	Variable costs – material (irrigation water) See quick scan for more details

conditionalities see OECD, 2005 in Pieters pp.79-85):	
o the distribution of market power (please identify the degree of concentration of factor and goods markets e.g. monopoly, free market):	There is no market for water (with the exception of some limited water trading). The price of water is set by public authorities. The market of agriculture produce can be considered a free market.
In the light of the above points, does the conditionality of the subsidy lead to higher production volumes and therefore rates of exploitation of natural resources? Note that this is considered to be analytically the most difficult task (Pieters, 2003),[5] hence some qualitative considerations will be acceptable here if more detailed data are not immediately available. o YES – if it leads to higher volumes, subsidy removal is likely to have significant environmental benefits. o NO - if there the production volumes are not likely to change, the subsidy's removal is not likely to have a significant environmental benefits Please justify your answer.	YES. Irrigation water subsidies affect the choice of crops, leading to the farming of more profitable crops with higher irrigation needs. This in turn leads to a higher consumption of water (see quick scan 3.1 for increase in water use due to subsidies). An example of how the composition of crops may change due to different water pricing in three typical areas in Spain is provided in table 6 of section 1.6 (crop plan by demand segment). The subsidy removal (i.e. an increase in the price of water) is expected to stimulate a change of the production pattern, or of the irrigation technology used (i.e. the adoption of more efficient techniques), so that water abstraction will decrease.

Summary of the results of the application of the checklist to the case	
1. Is the subsidy removal likely to have significant environmental benefits?	Subsidy removal may have significant environmental benefits, depending on the area and on the type of farmer. Elasticities can be different and therefore the effect of higher water prices on water consumption can be more or less pronounced. In some cases only very high water prices can lead to significant water consumption reduction, but with significant income losses for farmers. For instance a very inelastic water demand was observed in the Guadalquivir area in Spain regarding high value crops that are already under drip irrigation (olive, citrus and other fruit, which represent 44 per cent of water consumption and 47 per cent of area). When significant water saving is already in effect and high-value crops may bear price increases, water demand becomes more structural and rigid and the likely effect of subsidy removal is that the impact will go directly to decrease farmer's income (Berbel, Calatrava and Garrido, #: 17). A detailed analysis of elasticities at local level may be needed in order to understand in which areas a change in price is more (or less) likely to induce a significant reduction in water consumption. In order to be effective, and especially in those areas where elasticity is particularly

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[5] For more hints from the author on the reasoning behind this step, see sections 1.5 and 2 in Chapter 2 OECD 2005. Note: It is difficult to assess lock-in effects quantitatively, since it would require comparing a "with-situation" to a counterfactual "without-situation" (what technologies would have gained market access in absence of the subsidy?). But subsidies that are maintained over a long period are much more likely to have strong lock-in effects, especially when they also directly influence the choice of materials and energy. Taken from OECD 2005 p. 77.

		low, water pricing should be accompanied by other measures that address structural factors, agronomic conditions and financial constraints that affect the adoption of water conservation technologies and practices. Also, adequate monitoring will be crucial to make alternative measures effective. Flanking measures or ad-hoc approaches may be needed to reduce impacts on low-income farmers.
2.	Is the exclusion criteria system – i.e. YES/NO approach - a valid approach?	The answer can in some cases be both 'yes' & 'no', as this may depend on the kind of producer. This 'no' should not stop the analysis.
3.	Is the support worthy of further scrutiny to assess whether their reform/removal would benefit the environment?	Yes.
4.	What are the impacts of the subsidy on trade (what are they, are they important?).	See 1.5 of the quick scan

Some additional questions on the use of the checklist	
Based on the application of the tool to your case study, do you think it is possible to use the checklist and produce credible results without employing a general equilibrium model?	Yes. For this case sufficient information was available from the existing literature

1.3 Testing the INTEGRATED ASSESSMENT FRAMEWORK

1.3.1 *Features Scan*

The *features scan* asks in part what the impacts of a subsidy are or could be expected to be in relation to its stated objectives.	
1.1. *Subsidy objectives***:**	
• *What are the objectives of the subsidy, with respect to its environmental, economic and social impacts*? Suggestion: the official objectives may be surmised from the legislative history or statements by officials. The objectives may be expressed in terms of environmental economic or social outcomes or some combination of the three.	A subsidised water price makes irrigated agriculture more profitable. Traditionally, irrigation has been used to increase productivity and enable people to settle in rural areas, and as an instrument for combating desertification.
1.2. *Subsidy design:*	

• *Does the policy design avoid problems inherent in long-term existence of subsidies?* For example, does it have a sunset clause or an adaptive review process (i.e. does it have an in built review process and are subsidies tied to outcomes not technologies)*	No For duration see step 3 point 1 of the checklist
• *Are the conditionalities right?* To answer this question, do consider if subsidies are applied to inputs or are conditional to the use of specific technologies, or if they target outputs (see note below) etc, also building on the analysis made for Step 3 in the checklist or Linkage 1 of the quick scan. For more on the importance of conditionalities see OECD, 2005 in Pieters pp.79-85.	Conditionalities target the price of water, which is a variable production cost for farmers. Subsidies decrease production costs, but at the same time incentivise an inconsiderate use of water, promoting the farming of more water intensive crops – which can be more profitable for farmers, but arguably lead to water over abstraction. Furthermore, the subsidies remove or decrease the price signal related to water consumption and therefore do not provide sufficient signal to stimulate water efficiency, such as the introduction of water efficient technologies (e.g. drip irrigation) or the renewal of old infrastructures, which currently are responsible to huge losses due to leakage. The increased use of the factor targeted by the subsidy, irrigation water, affects the environmental and society at large. Environmental impacts are aggravated by the widespread problem of water scarcity which affects many EU countries. Although successful in keeping production costs down and stimulating more profitable crops, water subsidies have hence substantial drawbacks. Arguably subsidies could target other factors in order to avoid water overuse, the uptake or more efficient irrigation techniques should be promoted and/or flanking measures should be put in place to reduce the economic burden of a higher price of water.

1.3. *Effectiveness analysis***:** The effectiveness analysis (i.e. does the subsidy achieve its objectives?) should be based on the stated objectives of the policy. Where such goals are not explicitly stated or cannot be inferred, skip this section. Any environmental or social impacts would be considered unintended and would be addressed in the incidental impacts scan below (section 2 of the integrated assessment). This test is a sort of basic threshold criterion: if the subsidy fails at achieving even those objectives for which it aims then it is in need of reform regardless of its incidental impacts. So this is a powerful argument for reform. Possible sources: studies on macro-economic impacts or studies on micro-economic impacts of the subsidy. Please answer the points below.

• *Does the subsidy achieve the economic impacts that it is expected to achieve?* (e.g. correct a market failure; increase the supply of a public good) • What effect does the subsidy have on the (public?) budget and on welfare?	Yes, it provides support to farmers' incomes. By allowing a low price of water for irrigation it reduces variable costs of production, and allow the farming of more profitable water intensive crops. The public budget is arguably reduced by the foregone revenues from water charges. Gómez-Limón and Riesgo (2004) estimated the potential public revenues from increased water pricing in the Community of irrigators of the Pisuerga Channel in Northern Spain, taking into account different tipologies (clusters) of farmers – see section 3.1 of the quick scan for details. The table below summarises the public revenues per hectare associated to different price increases (from 0.01€/ha to, 0.04€/ha and 0.06€/ha) Tab 9: Public revenues (€/ha) in the Pisuerga area

	Medium price 0.04 €/m³	FCR price 0.06 €/m³

Cluster 1	248	365
Cluster 2	64	84
Cluster 3	97	95

Source: Gomez-Limon 2004

• *Does the subsidy reach the intended recipients? (e.g.* improving income distribution generally, reaching a target group with intended benefits; inducing socially desirable behaviour).	Yes - farmers
• *Does the subsidy achieve its environmental objectives? – only relevant for those which have*	No environmental objective

1.4. *Cost-effectiveness*: what alternatives exist for meeting those objectives that might be more cost-effective? In other words, could the objectives of the subsidy be achieved by other, more cost effective policies? Suggestion: one way of doing this is by comparing the cost of subsidy per unit of product with the cost per unit of an equivalent product. Note this step helps set the stage for the analysis of the impacts of policy reform. While collecting new, detailed information on the cost effectiveness of alternative policies, if not readily at hand, can be time consuming and costly, the analyst should at least consider and describe alternative policies

• *What alternative policies exist for meeting those objectives? Please describe:*	• **Support to more effective and targeted irrigation techniques** and introduction of an appropriate **monitoring system**. • **Replacing flat rates with volumetric rates** – i.e. water price would depend on the quantity used. Possible drawbacks of this measure are that efficiency gains may not justify the cost of restructuring tariffs, volumetric charges can have wealth re-distributional effects in large districts with network losses, and the lack of appropriate water-metering devices in irrigation districts can hinder the adoption of volumetric rates (Berbel et al, 2007:10). • Use **quantitative controls**. • Further consideration of **compulsory water use practices** in the code of Good Practices of the RDP and the cross-compliance scheme of CAP.

1.3.2 *Incidental Impacts*

The analysis of incidental impacts asks what impacts have occurred, or might occur, in areas (environmental/economic/social) not foreseen or targeted in the original subsidy design. The stress here is on long-term, dynamic and international impacts (e.g. this includes any impact of the subsidy on foreign producers – which should be noted in the analysis).	
• *What are the unintended economic impacts of the subsidy?(e.g.* unintended economic impacts such as impacts on the prices of factors of production and intermediate inputs used by non-target industries; or economic impacts of social and environmental changes brought by the subsidy).	Changes in relative prices of agriculture produce, i.e. lower prices of irrigated crops due to reduced production costs, thanks to water subsidies. This can for instance affect trade – for effect on trade see point 4 of the quick scan summary.
• *What are the unintended social impacts of the subsidy? (e.g.* socially undesirable distributional impacts such as on low-	None

income consumers, on non-target population generally, on developing country exporters). In order to answer this question Barg et al. (OECD, 2007) suggest describing the characteristics of the various social groups.[6] • *Are there any impacts on social groups in third countries deriving from the existance of the subsidy? If ye*s, describe them. Are they important?	
• *What are the unintended environmental impacts of the subsidy? T*hese are mainly linked to primary economic impacts – changes in the levels of inputs and wastes *e.g*. degradation of ecosystem services; loss of biodiversity, synergistic effects. See also your answer to linkage 3 in the quick scan.	The main impacts are water over abstraction and increased pollution from fertilizers. See quick scan 3.1 for details.

1.3.3 *Long-Term Effectiveness*

Too often, a subsidy designed to solve a short term problem may easily become the cause of problems in the longer term. In this section, the analyst needs to ask whether the subsidy is merely treating the symptoms of a larger problem, or whether it actually addresses underlying causes. The assumption is that, if the former is true, the subsidy may in fact be delaying necessary structural change.	
• Is the subsidy designed so as to eventually address the economic underlying problems that gave rise to its creation? e.g., by spurring innovation, increasing resource or labour productivity or increasing the supply of a public good?	No. Low charges eventually translate into poorly maintained water infrastructures, which in turn reduce irrigators' competitiveness and 'capacity to pay'. Low water prices influences the selection of crops leading to unsustainable patterns and low-value subsidised cultures (Berbel et al, 2007). Low prices and per hectare tariffs do not provide a market signal to use water efficiently, and as such do not incentivise the modernisation of irrigation techniques.
• Is the subsidy aimed at addressing underlying social problems or to treat symptoms, and therefore perpetuating a social 'lock-in'?	It addresses underlying social problems (i.e., farmers' poor welfare in deprived areas). However, it does it in an untargeted way – ie it is not addressed to the specific cluster in need of support. Subsidies to water services (mainly to construction of infrastructures) benefit all – i.e. farmers with high and low rents, big and small landowners. Subsidies to farmers with revenues from 40,000 to 80,000 EUR/ha (common in the south coast - Ministerio del Ambiente, 2008) are less justifiable from a social perspective as, arguably, they do not address issues of equity or affordability. Moreover, there is an opportunity cost for this water related to different potential users, since in profitable areas urban uses compete with agricultural use and environmental services (the latter information is due to be available in the River Basin Plans expected in December 2009). Subsidies to farmers in the interior with income of 300EUR/ha or less (Ministerio del Ambiente, 2008) may make sense because otherwise farmers will be driven away from agriculture, since the subsidies removal might drive away less profitable crops in these deprived areas (these are poor areas, although not all water deprived areas qualify as

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[6] Basically this question asks who gains and who loses? This analysis asks first whether a subsidy entails a net benefit or a net cost for non-target populations. Subsidies usually involve a transfer from one segment of the population to another something which may be justified on social welfare grounds, but which should be made explicit in any impact analysis. Ideally the transfer effects of any subsidy should be neutral or in the direction of a more-equal distribution of wealth or income (and distribution of non-income public goods), and should work to the benefit (or at least not the detriment) of socially marginalized populations.

	such).
	Furthermore, water subsidies do not take into account the effect of water availability in the long run. That is, although the subsidy provides some financial support in the short run (i.e., if the subsidy were to be removed, a decrease in farmers' income will be likely in the short run), a higher water consumption induced by the subsidy may lead to reduced availability of water in the future, leading to income losses in the long run.
• Is the subsidy designed to directly address the environmental problems (e.g. problems facing infant industries?	No.

1.3.4 *Policy Reform*

This is the final stage in the analytical framework. It involves highlighting the costs and benefits of the various options for reform, including outright elimination of the subsidy, phased elimination, changed policy design, and alternative measures. The analyst will also need to ask what sorts of flanking measures might be considered as a palliative complement to the various reform options.

• What would be the environmental, economic and social impacts of various scenarios for reform of the subsidy, including outright elimination, phased elimination, and change in policy design? Would they differ from a simple reversal of the incidental impacts discussed above?	Increase of water prices is expected to lead to irrigation practices with less water loss – although CAP subsidies for certain water demanding crops may reduce the effectiveness of water price increases. However, the adoption of those practices may require significant investment from farmers. The reform of water subsidies can take several forms. It can either be though an outright elimination or a phased elimination of the subsidy. In case of *outright* elimination, the substitution of cultures with less water intensive ones can be used as a flanking measure, if financial support and technical advice aimed at such substitution is provided by the authorities to farmers simultaneously with the removal of the subsidies. Alternatively, if a *phased* elimination is chosen, authorities can direct crop selection towards less water intensive cultures by providing financial support and technical advice without removing the subsidies immediately and wait for the impact the change is due to have on water consumption. This is due to involve slower progress in water efficiency than the scenario where substitution of cultures is accompanied by the removal of the subsidies, since imposed substitution of cultures might not be feasible. However, such approach involves a smaller threat to farmers' income. If water demand is relatively inelastic, small increases of water prices might have an important effect on the prices of agricultural products, the competitiveness and the income of farmers (Assimacopoulos, 2000). The removal of the subsidy can lead to significant impact on farmers' income. Berber et al (2000) estimates that farm income will decrease by about 40 per cent before water demand decreases significantly. A reduction in the number of crops available for farming can also lead to greater technical and economic vulnerability of the agricultural sector. Employment is likely to be effected - both directly on farms and indirectly on processing facilities. However, although water elasticity is generally low, it tends to differ across different areas (e.g. technologies and crop alternatives available) and conditions (e.g price range) (see also point 1.6 of section 1.1.1 above). It will be crucial to identify the areas where water consumption will be more sensitive to small price increases – i.e. where the impact on income will be less disruptive.

	For instance, income impacts are likely to be more pronounced where the most obvious water saving techniques have already been implemented and land characteristics do not allow for crop diversification. Farming flexibility depends on cropping systems, productive patterns and farm size. There is an optimum supply of water for each crop and the water production function is not sensitive to price increases until a break-even point is surpassed, when a new crop is introduced or farmers simply go for rain-fed crops. However, wasted water can be reduced if appropriate technologies are introduced and crop selection and diversification can be adapted according to soil characteristics and water availability..
	The cases where technological improvement and crop diversification is possible at lower cost should be prioritised for reform. These include more productive regions that have not yet attained high water efficiency due to technological innovation and old water districts with higher water allotments and lower technological efficiency. Water demand instead is less elastic in regions of low productive capacity and modern water districts (Varela-Ortega et al, 1998:198). In these areas small reductions in water consumption appear only when water prices are high, yields are sharply reduced, dry farming may take place or land is abandoned and farm income decreases (Varela-Ortega, 1998:199).
	Furthermore, it should be taken into consideration not only the short term effects on farmer's income, but also the long term effects related to excessive water use induced by subsidies. Farmers' income will likely be reduced in the long run if water availability declines. Therefore a decrease of income today (due to subsidy reform) may prevent future income drops due to water scarcity – which in some case may be more dramatic and more difficult to predict than 'controlled' impacts induced by reform.
	Taking into account the uncertain effect that an outright removal might have on crop selection and farmers' income, and the risk that some farmers may be driven out of activity, such a radical approach might not be recommended even if flanking measures are implemented.
	Due to socio-economic impacts, phased elimination of subsidies might be preferred to outright removal. Phased elimination can take the form of a change in the design of water price with the introduction of raising blocks (volumetric) tariffs or a zero price for a first block of consumption. Both solutions would not discriminate among farmers with different incomes and, consequently, different needs of support.
	A first block price-free can be set equivalent to what might be considered the minimum average consumption necessary for the cultures deemed appropriate for the region according to the technological status quo. However, this approach has a drawback. It does not provide an incentive to technological development and the adoption of new technical solutions until higher levels of consumption are reached. Such stimulus might be provided when raising blocks (volumetric) tariffs are adopted, since lower levels of consumption represent lower water costs that can be cashed by farmers through lower prices for final products. Therefore, raising blocks (volumetric) tariffs seem to be the preferable option. These tariffs can be improved if they are tailored taking into account the water necessary to cultivate the species most adequate to the region and the level of technological development available.
• Where negative impacts are predicted, what sorts of flanking measures might be helpful in addressing the negative impacts?	Both social and economic negative impacts are expected to follow the removal of water subsidies, especially in terms of reduced farmers' income, reduced level of employment and, in extreme cases, land abandonment. Negative impacts can be addressed either through 1) flanking measures that support the removal of water subsidies, reducing the negative impact this removal might have on farmers' income (for instance, financial means could be made available to

Conditions necessary for successful transition have been analysed by Cox A. in OECD 2007, also some examples of compensation have been included in IEEP et al. (2007)		farmers for investment either through direct allowances or cheap credit; capital costs could be lowered in an amount proportional to the subsidies removed);
	2)	compensatory measures that make up for the farmers' income loss following the removal of water subsidies in sustainable ways. For instance, farmers improving substantially their water efficiency can be rewarded by being eligible for water premium tariffs or being allowed to delay their move to the next price block when raising blocks (volumetric) tariffs apply.

Measures that address negative economic impacts through production changes (e.g., adoption of new technologies and production processes, introduction of new cultures with crop replacement and crop diversification) that improve farmers' competitiveness and consequently support farmers' income should be preferred to the ones that address primarily farmers' income. This is so since the former tend to be transitory, enabling the individuals to recover or improve their initial income without further support in the medium term, whilst the latter tend to delay the adaptation to the new conditions.

Among the means that could be used to provide flanking and compensatory measures are national and regional funds now used to finance irrigation equipment and water prices. It would be useful to divert these funds to supplement CAP cross-compliance measures and implement crop diversification, drip irrigation techniques accompanied by quantitative controls as well as complementary measures of rural development that will ensure the maintenance of rural livelihoods in the area.

• What would be the impacts of subsidy reform on trade? Would the removal of a subsidy have spill-over effects, i.e. favouring production overseas, favouring industry moving abroad? And what would be impacts on balance on the environment (please describe your assumptions and base your answer on a literature review – clearly specifying the literature consulted)	Subsidy removal could affect 'virtual water'. Changes in crop plans could lead to importing water-intensive products in areas where the price of water is very high and exporting products which do not require so much water (Velázquez, 2006). However, this might not happen in Spain in water deprived areas with high value added farming until a very high water price is reached and farmers stop their activity rather than change their crop selection.

Summary of the application of the integrated assessment to the case study	
1. Is the subsidy currently justified by any relevant market failure	No
2. If yes, is there an alternative way to tackle that market failure?	-
3. Is the subsidy currently justified by any	Not in all cases. It might be justified to support farmers'

	strong social concern? *(Note: a number of subsidies were launched where there was a strong social concern, although this may not always still be the case).*	income in deprived areas.
4.	If yes, is there an alternative way to tackle that social concern?	Through better targeted subsidies linked to compliance with environmental rules and practices as well as complementary measures of rural development that will ensure the maintenance of rural livelihoods in deprived area.
5.	Have there already been attempts to remove this subsidy, and if yes, why they failed? *(eg opposition by vested interests, public perception concerns, lack of political will given negotiating capital)*	There have been successful attempts. For instance, in the Genil Cabra and Fuente Palmera irrigation co-operatives, in the Guadalquivir river basin, a new water charging structure was implemented to replace the old area-based charge (Maestu, 1999). The new approach included both a fixed and variable charge linked to water use, with farmers paying, on average, significantly more than under the original area-based approach. This has resulted in a 30 per cent reduction in water consumption (for the same crop types), leading to about 2,000 m³/ha of water saved per year (Maestu, 1999). Resistance from farmers to new water prices has been a crucial obstacle for the success of reform. This resistance might be due both to communication failures (authorities do not successfully lay out the benefits of the change) and the non-inclusion of flanking or compensatory measures in the reform proposals. The fact that farmers' tend to consider their water endowments as historical rights raises the resistance to any legal change that may impose a social burden on farmers/landowners.
6.	Could you make recommendations on possible compensation measures that could be used to palliate impact of removal?	Financial support and technical advice could be provided by the authorities to farmers aimed at substitution of cultures (crop diversification and crop replacement) with less water intensive ones. Financial means could be made available to farmers for investment (e.g., in drip irrigation techniques) either through direct allowances or cheap credit. Farmers obtaining best results in water efficiency can be rewarded by being eligible for water premium tariffs or being allowed to delay their move to the next price block when raising blocks (volumetric) tariffs apply. National funds could be used to supplement CAP cross-compliance measures and implement crop diversification, drip irrigation techniques accompanied by quantitative controls as well as complementary measures of rural development that will ensure the maintenance of rural livelihoods in the area. Public revenues from higher water prices could also be used to improve obsolete water supply networks.
7.	What would be the impacts on trade of the subsidy removal? Will it have any global environmental impacts?	Regional crop specialisation might change (some water-poor regions are currently specialised in water-intensive cultures, e.g. potatoes, vegetables, citrus fruit and orchards in Andalusia – Velázquez, 2006) and consequently the subsidy removal might affect 'virtual water' (imports of water-intensive products to areas where the price of water is very high and exports of products which do not require so much water (Velázquez, 2006)). However, this effect is likely to be minimal since other structural factors and agronomic conditions, such as land potential productivity, will hinder the change of present trade patterns.