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The economic impact of the Tajo – Segura aqueduct

Adding value to the ***Sindicato Central de Regantes del Acueducto Tajo-Segura***

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About this report

This report has been prepared exclusively for the 'Sindicato Central de Regantes del Acueducto Tajo-Segura'. The report presents the findings of the work performed by PricewaterhouseCoopers Asesores de Negocios, S.L. regarding the economic impact of the Tajo-Segura aqueduct. It has been prepared in accordance with our engagement letter, dated 23 April 2013, and its accompanying terms and conditions.

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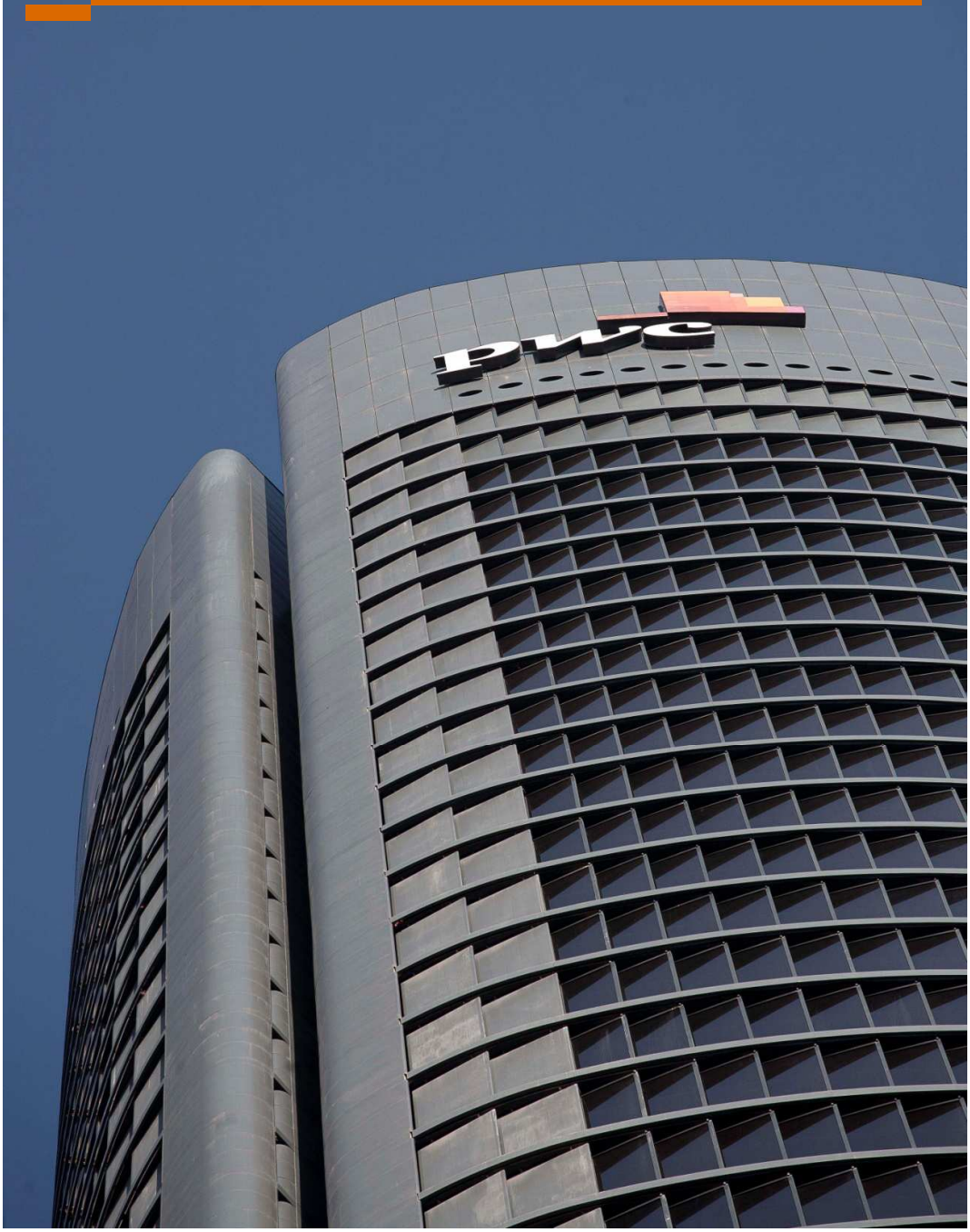

List of abbreviations

AWU: Annual Work Unit.

CNAE: National Classification of Economic Activities (Clasificación Nacional de Actividades Económicas).

DIRCE: Central Directory of Companies, compiled by Spain's National Institute of Statistics (Directorio Central de Empresas del INE).

EBIT: Earnings Before Interest and Tax.

EU: European Union.

FTE: Full Time Equivalent.

GDP: Gross Domestic Product.

GVA: Gross Value Added.

INE: Spain's National Institute of Statistics.

MAGRAMA: Ministry of Agriculture, Food and the Environment (Ministerio de Agricultura, Alimentación y Medio Ambiente).

MCT: Taibilla Waterway Association (Mancomunidad de Canales de Taibilla).

OECD: Organisation for Economic Cooperation and Development.

SABI: Iberian Balance Sheet Analysis System (Sistema de Análisis de Balances Ibéricos).

SAT: Agrarian Transformation Company (Sociedad Agraria de Transformación).

SCRATS: Central Syndicate of Farmers with Irrigation Rights of the Tajo-Segura Aqueduct (Sindicato Central de Regantes del Acueducto Tajo-Segura).

Note: throughout this document, we use the term "aqueduct" in the broadest sense of the word, as the translation for the term "trasvase", where aqueduct is understood to be "a conduit used to convey water over a long distance".

Contents

Executive Summary

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This report has been prepared by PricewaterhouseCoopers Asesores de Negocios, S.L. (hereinafter, PwC), for the 'Sindicato Central de Regantes del Acueducto Tajo-Segura' (SCRATS). It contains the findings of a study performed by PwC to evaluate the socio-economic impact of the Tajo-Segura aqueduct on the regions that receive water from that aqueduct.

The study focuses on the measurement of the economic activities linked to the water transported by the aqueduct. Specifically, the activities considered include agricultural irrigation, which ultimately consumes the majority of the water transported by the aqueduct, as well as the marketing and processing of fruit and vegetable products that form part of the same value chain. We have also analysed the tourism sector, since some of the transported water is used for the domestic and industrial supply of some of the most important tourist towns in the region.

In order to measure the impact, we have taken into account not only the direct effects of the activities described above, but also the indirect and induced effects of the activities that form part of the value chain of the sectors that are directly affected by and/or that benefit from the increase in wealth in the region, and the associated increase in household consumption.

The study is based on data obtained from public sources (from MAGRAMA and the Ministries of Agriculture in the regions affected by the aqueduct, amongst others), from a questionnaire completed by a sample of farmers, fruit and vegetable traders and processing companies in the region affected by the aqueduct, and from SCRATS. The estimation of the indirect and induced impact has been performed using an Input-Output model based on data from Spain's National Accounting register.

Agriculture is one of Spain's strategic sectors

Firstly, the findings of the study show that agriculture, which is the main beneficiary of the water transported by the aqueduct, is a strategic sector for Spain. As such, its development and maintenance are in the public interest, both in general, as well as during times of economic crisis, such as the period we are currently experiencing. Thus, the weight of the primary sector in Spain is considerably higher than the EU average, and countries such as Italy, France, Germany and the UK. This is explained in part by the competitive advantage that exists in Spain, given the exceptional climatic conditions in certain areas of the country, which are difficult to replicate and which facilitate production even during the winter months.

Moreover, the agricultural sector makes a positive contribution to the balance of trade surplus, thanks to its high export potential. Specifically, fruit and vegetable products account for around 6% of Spain's exports and in 2012, they yielded a positive balance that exceeded €6,500 million. Agriculture also encourages the development of a number of associated industries, including not only (food) processing, but also those involved in the supply of the goods and services required by the agri-food sector (machinery, pesticides, transport, packaging, etc.).

Finally, agriculture constitutes a means of generating employment and preserving the rural population. The available evidence shows that the populations in Alicante, Murcia and Almería, for example, have grown significantly in recent years, by more than the national average and by significantly more than those in typical rural areas, both when we consider all municipalities, as well as when we look at non-tourist towns only.

The region affected by the aqueduct is a key component of this strategic sector

Much of the region affected by the aqueduct is highly dependent on agriculture in economic terms. The weight of the primary sector in the Region of Murcia (5.4% of GDP and 10.2% of employment) and in Almería (13.1% of GDP and 19.6% of employment) ranks well above the national average (2.6% of GDP and 4.2% of employment).

At the same time, the provinces in the region affected by the aqueduct make a greater relative contribution to the agricultural sector. Specifically, Alicante, Murcia and Almería account for more than 35% of Spain's fruit and vegetable exports and the sector's contribution to the balance of trade surplus is around 60%.

Finally, we have observed that the crops in the region affected by the aqueduct have a high added value component and/or use water very efficiently. Their yields, in terms of margin per cubic metre of water consumed, are much higher than the Spanish average (€0.55/m3 versus €0.29/m3) and are only surpassed by the basins of the Canary Islands (€0.91/m3) and Southern-Andalucía (€1.32/m3).

On aggregate, activities relating to agriculture in the region affected by the aqueduct contribute €2,364 million to GDP and support more than 100,000 jobs

Agriculture

In recent years, there has been a gradual shift in the types of crops grown in the region affected by the aqueduct, with traditional staples making way for new varieties. This has been accompanied by an intense modernisation and automation process, which has placed the region amongst the best in Europe in terms of technological development. For example, 80% of the irrigation in the region affected by the aqueduct uses localised irrigation systems, which make better use of the water resources, compared with the national average, which sits below 50%.

The widespread implementation of high-tech irrigation systems in the region affected by the aqueduct has facilitated the development of local companies, which now sell their technology and components around the world. These include manufacturers of valve systems, software and hardware for automated processes, as well as projects for the integration of turnkey automated systems.

According to our estimates, agriculture in the region affected by the aqueduct contributes €1,286 million to annual GDP, which represented 2.8% of Murcia and Alicante's aggregate GDP in 2010. Of that total, the direct impact generated within the agriculture sector itself accounts for 45% (€583 million), which represents around 30% of the agricultural GVA in Murcia and Alicante. The indirect impact or carry-over effect in the supplier value chain amounts to €447 million, whilst the induced impact amounts to €256 million.

In terms of employment, the agricultural sector in the region affected by the aqueduct generated 58,632 direct jobs in 2012, which represented 38.8% of all jobs in the agricultural sector in Alicante, Murcia and Almería, and 15,000 additional indirect and induced jobs.

Marketing and processing

Agriculture in the region affected by the aqueduct has been accompanied by the introduction and development of companies and enterprises dedicated to the marketing and processing of fruit and vegetable products. According to data from INE, there were 166 companies in the fruit and vegetable processing and preservation sector in the Region of Murcia alone in 2012. Examples include AMC, Hero and Juver, which rank amongst the top 5 companies in that sector in Spain.

Based on our estimates, marketing activity in the region affected by the aqueduct contributes €875.6 million to GDP, of which €448 million relates to the direct effect, generated by the marketing companies' own activity; €288.4 million comes from the indirect carry-over effect in the supplier value chain; and €138.4 million is generated by the induced effect. In terms of employment, marketing supported 25,278 FTE jobs in 2012, of which more than 16,300 were direct and around 9,000 were indirect or induced.

In terms of fruit and vegetable processing, the activity contributes €202 million to GDP, the majority of which (€133.6 million) is generated by the indirect effect. This activity also supports more than 5,000 FTE jobs, of which 1,344 are direct, 3,120 are indirect and 608 are induced.

Total impact

On aggregate, the total impact on GDP of all of the activities relating to agriculture in the region affected by the aqueduct amounts to €2,364 million, of which more than 50% corresponds to agriculture. The contribution to employment exceeds 100,000 FTE jobs, of which more than 70% correspond to agriculture. The relatively high weight of this activity in terms of employment is explained by the higher intensity that is required in terms of manpower in that sector compared with the marketing and processing industries.

A 10% reduction in the volume of transported water would result in a 4.3% decrease in agricultural production

We have performed a sensitivity analysis in order to evaluate the impact of possible variations in the volume of water transported. These variations may be driven by restrictions in the volume of water available at source, or by increases in the price of water in the context of the increasing scarcity of the resource in the future.

We estimate that a 10% variation in the volume of transported water would likely produce an immediate effect of 1% in terms of production. The effect over the medium-long term increases to 4.3%. The economic impact on the agricultural sector and its related marketing activity would be at least proportional.

The aqueduct reduces the risk of cuts in the water supply in tourist areas, and therefore contributes to a sector that employs more than 320,000 people in the affected region

Tourism accounts for 9.8% of GDP and 10.2% of employment in the Region of Murcia. Those figures amount to 12.6% and 13.4%, respectively, in the Community of Valencia.

Meanwhile, more than 95% of the population in the Region of Murcia and 57% of the population in Alicante are supplied by the Mancomunidad de Canales de Taibilla (MCT). In particular, it supplies some of the most important tourist towns in the region, including Santa Pola, Torrevieja, La Manga del Mar Menor, Mazarrón, Cartagena, Murcia and Alicante.

The aqueduct supplies the bulk of the water resources managed by the MCT; it accounted for 56% of the total water managed by MCT during the period 1986-2012, with one-off peaks in certain years, such as 70% in 1987. Despite the important contribution that the water transported by the aqueduct represents, in recent years, there have been water shortages and even restrictions on the supply. For example, in August 2003, 12-hour restrictions were imposed in 21 towns affecting more than 200,000 users in the Northeast of Murcia, Campo de Lorca and Cartagena.

Introduction: purpose and scope of the study

1

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1. Introduction: purpose and scope of the study

The Tajo-Segura aqueduct opened in 1979 and supplies water for agricultural use (irrigation), as well as for domestic and industrial supply in the areas of Alicante, Murcia and Almería.

The Hydrological Plan of the Spanish part of the Tajo River Basin is currently in the consultation phase, before being officially approved. This plan may have a significant impact on the volume of water allocated to the aqueduct going forward. [1]

Meanwhile, the Ministry for Agriculture, Food and the Environment (MAGRAMA), together with the Autonomous Communities of the Region of Murcia and the Community of Valencia, recently signed a memorandum of understanding, expressing the need to support the water planning process for the River Tajo, and in turn, proving the greatest possible security and stability to the operation of the irrigation system.

In this regard, the memorandum states that the maintenance of the aqueduct is a strategic objective, given the importance of the economic activities that are supported by the water it transports. According to the memorandum:

> *"Irrigation using transported water sustains fundamental socio-economic activity in large areas of the South-East of the peninsula and contributes to: development and employment in rural areas; a very high-tech and productive agricultural sector; and a very significant agri-food sector. For these reasons, the maintenance of the Tajo-Segura aqueduct and of a secure and sustainable agricultural sector constitutes a primary strategic and socio-economic objective for the State, and its continuation must be ensured."*[2]

In this context, our study has focused, on one hand, on providing a measure of the importance of the economic activities that relate to the transported water. At the same time, and in the face of the increasing scarcity of water as a resource in Spain, the study analyses the impact of a potential variation in the volume of transported water on those activities.

In order to calculate this measure, we have taken into account not only the direct effect, i.e., on the activities that receive transported water and use it within their production processes (for example, agriculture), but also the indirect and induced effects of the activities that form part of the value chain of the sectors that are directly affected by and/or that benefit from the increase in wealth in the region, and the associated increase in household consumption.

To carry out the study, we have used data obtained from public sources (including MAGRAMA and the Ministries of Agriculture in the regions affected by the aqueduct), from a questionnaire completed by a sample of farmers, fruit and vegetable traders and processing companies in the area, and from SCRATS. The precise information sources that have been used in the different analyses are detailed throughout the report, along with the procedures that we have adopted to crosscheck the data, where appropriate.

As we noted above, the study focuses exclusively on the assessment of the economic impact in regions that receive water from the aqueduct, which constitutes one of the significant elements of the debate surrounding the aqueduct. Therefore the study has not been performed from the perspective of a cost-benefit analysis and so does not take into account or quantify other possible impacts (such as environmental effects or others) for the rest of Spain.

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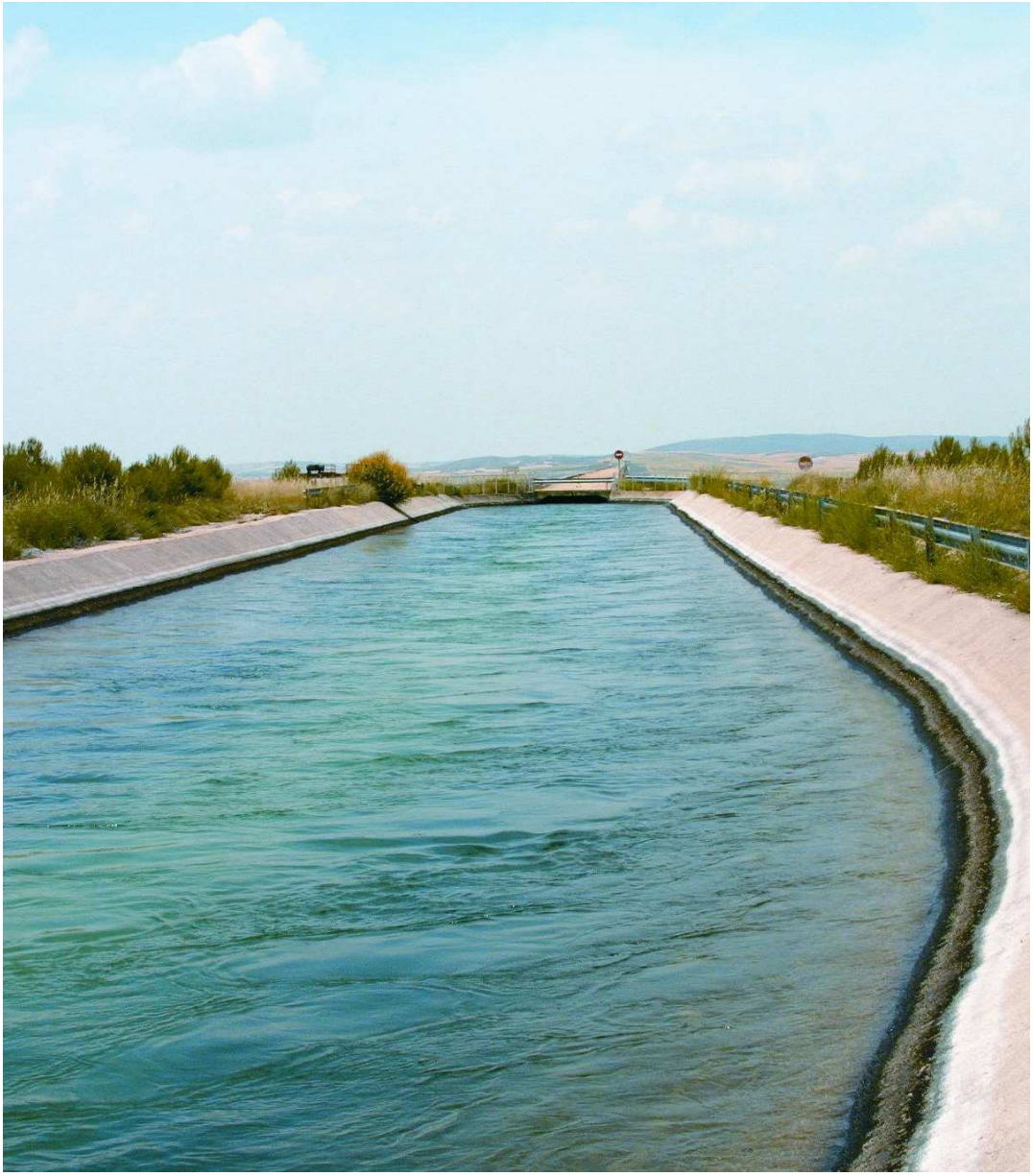
[1] For example, refer to the press release published by the Tajo River Hydrographic Confederation (MAGRAMA) on 19 June, 2013, available at http://www.chtajo.es/

[2] Memorandum of understanding between MAGRAMA and the Autonomous Communities of the Region of Murcia and the Community of Valencia regarding surplus water from the Tajo-Segura aqueduct.

1. Introduction: purpose and scope of the study

This report is divided into 4 main sections:

- In Section 2, we contextualise the study, providing a description of the aqueduct and of the importance of agriculture (the main beneficiary sector) for the regional and national economy.
- In Section 3, we focus on measuring the economic activities undertaken in the agricultural and related sectors (marketing and processing) in the region affected by the aqueduct.
- In Section 4, we analyse the tourism sector, which also potentially benefits from the aqueduct, although in a more indirect way.
- In Section 5, we present our findings.



The aqueduct and agriculture in the context of the regional and national economy

2

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2. The aqueduct and agriculture in the context of the regional and national economy

This section establishes the framework for the analysis of the impact developed later in this report. Specifically, we begin by presenting a description of the aqueduct itself and of the main uses of the water that it transports. We continue by analysing the role of the agricultural sector, as the sector most directly affected by the water transported by the aqueduct, and its strategic importance for the regional (in the receiving areas) and national economy.

2.1. The Tajo – Segura aqueduct

The Tajo-Segura aqueduct is one of the largest hydraulic engineering projects to have ever been completed in Spain. It opened in 1979 and facilitates the diversion of water from the River Tajo to the River Segura through a 292 kilometre long channel, which is open for the most part.

The channel starts alongside the Bolarque Reservoir, between the provinces of Cuenca and Guadalajara. From Bolarque, water travels down to the Bujeda Dam (Cuenca), and then onto the Alarcón Reservoir (Cuenca), which sits at the head of the River Júcar. From there it continues through a 31.9 kilometre long tunnel that leads to the Talave Reservoir (Albacete). This reservoir is located on the River Mundo, in the Segura River Basin. The last stage of the aqueduct involves transporting the water to the Azud de Ojós Reservoir, in the province of Murcia, from where it is redistributed to Alicante, Murcia and Almería. This redistribution is accomplished through two main routes:

- The Main Channel on the Left Bank or 'Canal Principal de la Margen Izquierda' (82 kilometres). This takes water from the aqueduct to the province of Alicante and the Campo de Cartagena.
- The Main Channel on the Right Bank or 'Canal Principal de la Margen Derecha'. There are two sections to this channel – on the one hand an 85-kilometre stretch that transports water from the aqueduct to Las Vegas Alta y Media del Segura, the River Mula region and the Guadalentín Valley and, on the other hand, the Almería Channel (42 kilometres), which carries water from Lorca to the Almanzora Valley.

The water from the aqueduct is used for two main purposes: irrigation for agriculture and domestic and industrial supply. The volume of water to be transported is determined in accordance with the regulated surplus flows from the River Tajo river basin, up to a maximum of 600 hm^3 per year. Upon arrival, this water is distributed to each area in accordance with the following table.

Table 1. Distribution of transported water by receiving area

	Volume (hm^3/year)
For irrigation	**400**
Vegas Alta y Media del Segura	65
The River Mula region	8
Lorca and the Guadalentín Valley	65
Levante and Vega Baja del Segura	125
Campos de Cartagena	122
The Almanzora Valley	15
For supply	**110**
Losses during transportation and distribution	90
TOTAL	**600**

Source: SCRATS.

2. The aqueduct and agriculture in the context of the regional and national economy

In terms of irrigation (agriculture), the aqueduct supplies water to a total of 147,276 ha of crops across 61 municipalities. [3] The majority of that surface area is located in Murcia (85,377 ha) and Alicante (58,878 ha). The remainder (3,000 ha) is located in Almería. The dominant crops in the region supplied by the aqueduct are vegetables, grown both outdoors and in greenhouses, citrus fruits and orchard fruits.

For the domestic and industrial supply, the bulk of the water transported by the aqueduct is managed by the Mancomunidad de los Canales de Taibilla (MCT), an autonomous body that sits under the Directorate General for Water (MAGRAMA). The MCT supplies water to 2.5 million inhabitants across 79 municipalities (43 in Murcia, 34 in the Community of Valencia and 2 in Castilla La Mancha), as well as other official entities and bodies. [4] In addition, a certain amount of water is used to supply the region of Almería.

Table 2 shows the volumes of water approved at source for the Tajo-Segura aqueduct, for the last three water years, broken down by type of use.[5] The table shows that more than 60% of the approved volumes were used for irrigation (agriculture), specifically 63.2% in 2009-10, 67.3% in 2010-11 and 71.0% in 2011-2012).

Table 2. Volume of water approved at source (Bujeda Dam) for the Tajo-Segura aqueduct, by type of use (hm3)

Water year	Supply			Irrigation	TOTAL
	Taibilla	Almería	Total		
2009-10	98.1	9.1	107.2	184.4	**291.5**
2010-11	113.6	9.9	123.5	254.5	**378.0**
2011-12	103.8	6.3	112.1	274.1	**386.2**

Source: The Segura River Hydrographic Confederation ('Confederación Hidrográfica del Segura') and SCRATS.

This study focuses on the measurement of the economic activities linked to the water transported by the Tajo-Segura aqueduct. As we have seen, the main beneficiary sector is agriculture, which uses water as a fundamental element in its production processes. The remainder of this section of the report is devoted to analysis of the importance of agriculture for the national and regional (area affected by the aqueduct) economy. This qualitative analysis will be used to weight and frame our quantitative estimates of the size of the economic activities associated with the agricultural sector supplied by water from the aqueduct, which will be presented in Section 3 of this report.

As we have also seen, the water transported by the aqueduct is used as a source of supply for the domestic and industry demand in numerous municipalities in Murcia, Alicante and to a lesser extent Albacete and Almería. Some of these municipalities are important tourist destinations and receive visitors from other parts of Spain and overseas. In this regard, the water transported by the aqueduct contributes to securing the water supply and to minimising the risk of restrictions over and cuts in the supply in the event of shortages, and so has supported the development of tourism, another key industry in the region. In Section 4 of this report, we evaluate the importance of the tourism sector in Alicante and Murcia, and the weight that the municipalities that are supplied with water from the aqueduct, have on this sector.

[3] The list of municipalities is presented in Annex A. There are 61 in total, of which 31 are located in Murcia, 26 in Alicante and 4 in Almería.

[4] The list of municipalities is presented in Annex A. From the total population supplied using water from the aqueduct, 56% live in Murcia, 43% live in Alicante and the remaining 1% live in the province of Albacete.

[5] Volume of water measured at the start of the aqueduct, at the Bujeda Dam. The actual water volume consumed is lower due, at least in part, to the losses that arise upon transportation and distribution. For example, according to data provided by the Segura River Hydrographic Confederation, the net aggregate consumption of water supplied by the aqueduct amounted to 343.9 hm^3 in water year 2010-11 (the latest period for which information is available) (compared with the volume approved at source, 378.0 hm^3).

2.2. Agriculture as a strategic economic sector

Table 3 shows the weight of gross value added (as a measure of the contribution to GDP) of the agriculture, hunting and fisheries sector, over the Spanish economy as a whole, and compares it with 4 other large EU countries, and with the EU average, based on data from Eurostat. Eurostat does not publish data at a more granular level for the agricultural sector. The table shows that the weight of the primary sector is substantially greater in Spain than in the comparative countries. Specifically, it accounted for 2.7% of GDP in Spain in 2010, compared with 1.9% in Italy, 1.8% in France (data from 2009), 0.9% in Germany and 0.7% in the UK; and 1.7% on average for the EU as a whole. These figures do not take into account the contribution made by the agri-food marketing and processing sectors, even though they depend on the primary sector to some extent.

As we describe in more detail below, this greater weight is explained, in part, by the exceptional climatic conditions in Spain, which boost crop yields by making production possible even during the winter months in certain regions.

Table 3. Weight of gross value added by the agriculture, hunting and fisheries sector over the total economy (2008-10)

Country	2008	2009	2010
Spain	2.7%	2.7%	2.7%
Italy	2.0%	1.9%	1.9%
France	2.1%	1.8%	n/d
Germany	0.9%	0.8%	0.9%
United Kingdom	0.8%	0.7%	0.7%
EU Average	1.7%	1.6%	1.7%

Source: Eurostat.

The strategic nature of agriculture in Spain does not stem only from its greater relative weight over GDP, compared with other countries in the region. There are a number of additional factors that justify the maintenance and development of the sector in the public interest, both in general, as well as during times of economic crisis, such as the period we are currently experiencing.

2. The aqueduct and agriculture in the context of the regional and national economy

Firstly, the agricultural sector in Spain has a competitive advantage over those in other countries, owing to the exceptional climatic conditions that some of its regions enjoy, especially in terms of hours of sunshine and temperature, which are difficult to replicate. These better climatic conditions stimulate production even during the winter months. In this respect, for example, the study performed by Aznar and Galdeano (2011) stated the following in relation to the climate in the province of Almería:

> *"Despite the low volumes of rainfall (150-200 mm per annum), the high temperatures and long hours of sunshine are an important asset for the development of fruit and vegetable production. The average annual temperature ranges between 15 and 20 degrees centigrade and never falls below 18 degrees on the coast, where the winter months are extremely mild (12-24 degrees) and the daily and annual temperature ranges are moderate, due to the regulating effect of the Mediterranean Sea, with little or no risk of frost. Some parts of Almería enjoy more than 3,500 hours of sunshine per year [...]. Moreover, Almería is an unusually windy province and that climatic feature is harnessed to control the climatic conditions inside greenhouses, whereby avoiding excessively high temperatures and humidity."*[6]

Secondly, the agricultural sector contributes in a positive way to our country's balance of trade surplus, which was traditionally in deficit, thanks to its high export potential. Table 4 shows the evolution of exports, imports and the balance of payments for the fruit and vegetable sector and for Spain as a whole between 2010 and 2012, based on data from ICEX. It shows that fruit and vegetable products account for around 6% of total exports and have had a positive impact on Spain's trade balance, with a balance that exceeded €6,500 million in 2012 (representing 21.2% of Spain's total trade balance).

Table 4. Weight of the fruit and vegetable sector over exports, imports and the trade balance in Spain (€ in thousands, 2010-12)

2010	Exports	Imports	Balance
Fruit and vegetable products	11,834,933.4	5,818,095.4	6,016,838.0
ALL products	186,780,070.6	240,055,850.1	-53,275,779.5
Fruit and vegetable %	**6.3%**	**2.4%**	**-11.3%**

2011	Exports	Imports	Balance
Fruit and vegetable products	12,230,126.1	6,287,799.9	5,942,326.2
ALL products	215,230,370.7	263,140,740.6	-47,910,369.9
Fruit and vegetable %	**5.7%**	**2.4%**	**-12.4%**

[6] Aznar and Galdeano (2011), p. 105. Translation of the original text in English: *"Despite the low volumes of rainfall (150-200 mm per annum), the high temperatures and long hours of sunshine are an important asset for the development of fruit and vegetable production. The average annual temperature ranges between 15 and 20 degrees centigrade and never falls below 18 degrees on the coast, where the winter months are extremely mild (12-24 degrees) and the daily and annual temperature ranges are moderate, due to the regulating effect of the Mediterranean Sea, with little or no risk of frost. Some parts of Almería enjoy more than 3,500 hours of sunshine per year and the figure is between 3,200 and 3,500 in the Campo de Dalías. Moreover, Almería is an unusually windy province and that climatic feature is harnessed to control the climatic conditions inside greenhouses, whereby avoiding excessively high temperatures and humidity."*

2012	Exports	Imports	Balance
Fruit and vegetable products	13,469,752.4	6,953,784.6	6,515,967.8
ALL products	222,643,893.8	253,401,248.8	-30,757,355.0
Fruit and vegetable %	**6.0%**	**2.7%**	**-21.2%**

NOTE: ICEX's statistics include exports and imports of fresh, frozen and processed (canned food, jams, juices, etc.) products within the category of fruit and vegetable products.
Source: ICEX.

Thirdly, agriculture also encourages the development of a number of associated industries, including not only (food) processing, but also those involved in the supply of the goods and services required by the agri-food sector to enable it to undertake its activity (including machinery, pesticides, transport, packaging, etc.). As we will see later in this report, some of these industries have focused on the development and marketing of initiatives to improve the management of water resources in the region affected by the aqueduct, whereby promoting a high-tech agricultural sector. In this regard, the study prepared by Martínez and Martínez (2011) refers to the auxiliary industries that have been developed around the sector in the region of Murcia:

> *"We have seen the growth of many auxiliary industries (transport, metal and plastic packaging, graphic art, pesticides, greenhouses, irrigation systems, agricultural and industrial machinery, food additives, etc.), as well as of advanced service companies (specialist logistics companies, innovation centres, transport, quality certification laboratories), which are now prominent players in the agri-food sector in the Region of Murcia. The companies dedicated to these related activities (manufacture of irrigation systems, pesticides, greenhouses, agricultural plastics, agricultural machinery, packaging, sterile food processing machinery and equipment, autoclaves, etc.) have now grown to such an extent that many are leading suppliers of know-how in their respective areas on the international stage."*[7]

Finally, agriculture constitutes a means of generating employment and preserving the rural population.[8] The development of the associated agri-food industry in the region also fosters the creation of jobs in other sectors for people with different professional qualifications. In this regard, the OECD noted in a study in 2009 that the reduction of the rural population is one of the greatest challenges facing Spain, and that agriculture continues to be the main driver for maintaining the population and employment in this area. According to the OECD:

> *"Putting a stop to rural depopulation is the main challenge facing Spain. A large part of the country suffers from problems of depopulation owing to the poor living conditions associated with the topography, the climate and the scarcity of water, amongst other factors. The primary sector (agriculture, hunting and forestry) continues to be the main driver for maintaining population and employment in rural areas."*[9]

[7] Martínez and Martínez (2011), p. 186.

[8] Some studies have also highlighted the role of agriculture in the provision of food, and its impact on the landscape, biodiversity and rural life. See, for example, De Stefano and Llamas (2013) and Castañón (2009).

[9] OECD (2009), p. 4. Translation of the original text in English: *"Putting a stop to rural depopulation is the main challenge facing Spain. A large part of the country suffers from problems of depopulation owing to the poor living conditions associated with the topography, the climate and the scarcity of water, amongst other factors. The primary sector (agriculture, hunting and forestry) continues to be the main driver for maintaining population and employment in rural areas."*

2. The aqueduct and agriculture in the context of the regional and national economy

Meanwhile, MAGRAMA has also referred to the agri-food sector as a whole, as a generator of employment and as essential for maintaining the population in the rural environment. According to MAGRAMA:

> *"The agri-food sector is a top priority, therefore, not only due to its importance as the leading industrial sector in Spain, but also due to the key role that it plays in increasing the added value of agricultural and forestry products. Furthermore, it acts as a catalyst in rural areas, as a guarantor of food quality and security, as well as a generator of employment; it is essential for maintaining the population in rural areas."*[10]

Figure 1 shows the population growth in the provinces affected by the aqueduct, namely, Alicante, Murcia and Almería, between the years 1970 and 2012, and compares this local data with the figures recorded in other parts of Spain. This comparison is performed on one hand, taking into account all of the municipalities in Alicante, Murcia and Almería (on the left hand side of the graph). On the other hand, and in order to filter the impact of the development of the tourism sector in these provinces, the comparison is performed considering non-tourist municipalities only.[11]

The comparison is also drawn between population growth in the provinces affected by the aqueduct and the rest of Spain, as well as with Castilla y León (including and excluding provincial capitals), as a benchmark for a primarily rural area. Finally, we compare Alicante with the other two provinces in the Community of Valencia.

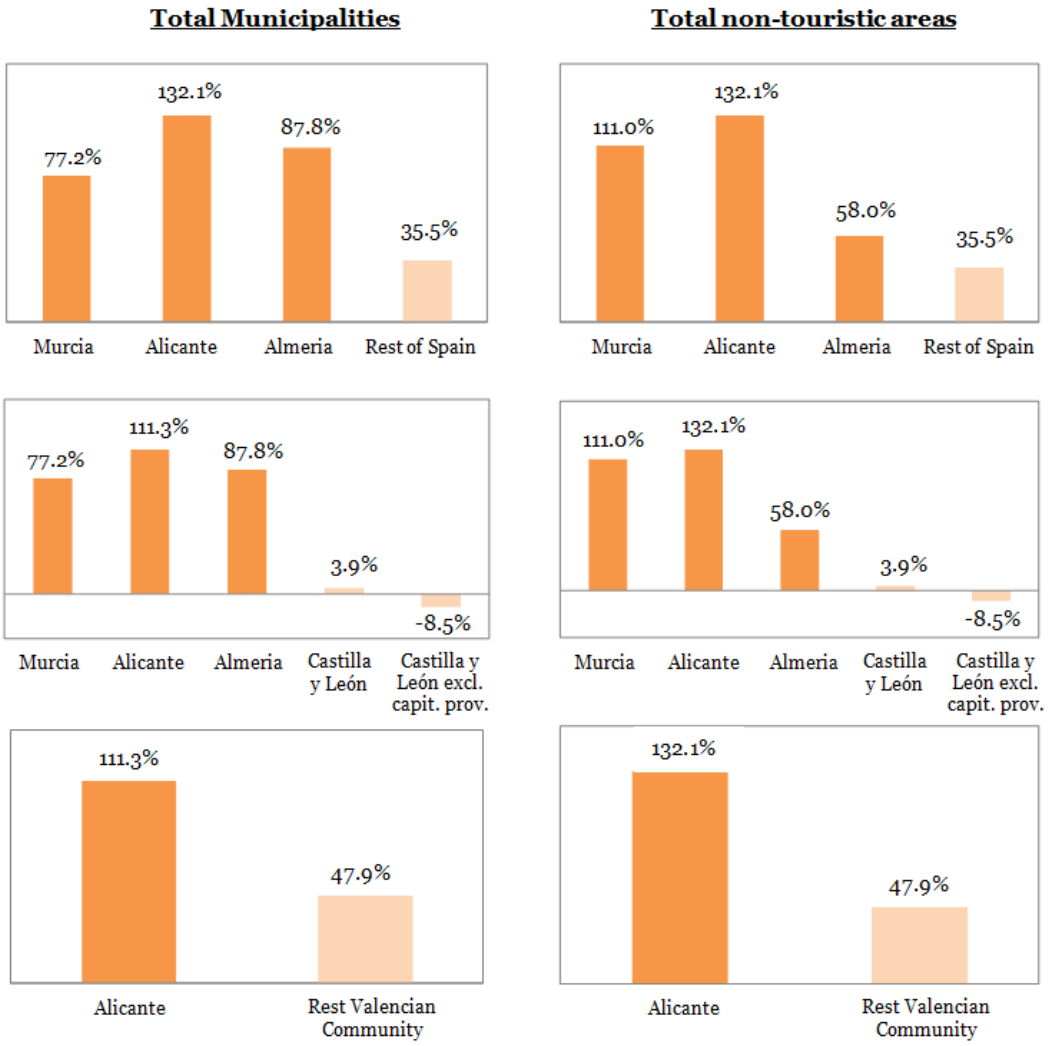
In every case, regardless of whether we consider all of the municipalities or just the non-tourist municipalities, the graphs show that the population of Alicante, Murcia and Almería has grown very significantly, by more than in the rest of Spain and by significantly more than in Castilla y León during the period. This evidence is consistent with the existence of an effect that has fixed the rural population, at least in the region affected by the Tajo-Segura aqueduct.

[10] MAGRAMA (2012), p. 109.

[11] When determining whether a municipality is dedicated tourism, we have used the classifications assigned by the Ministry for Tourism, Trade and Consumer Affairs in the Region of Murcia in its Tourism Master Plan, and by the Valencian Federation of Municipalities and Provinces in a recent study. For Almería, we have considered the municipalities that appear on the following website as tourist municipalities: http://www.andalucia.org/.

2. The aqueduct and agriculture in the context of the regional and national economy

Figure 1. Evolution of the population in provinces affected by the aqueduct compared with other benchmark areas (1970-2012)



Source: INE.

2.3. Agriculture in the region affected by the Tajo-Segura aqueduct

Table 5 shows the weight of the agriculture, livestock, forestry and fisheries sector over total gross value added and employment in the provinces affected by the aqueduct and in Spain as a whole. The figures show that in two of the provinces affected by the aqueduct, Murcia and Almería, the weight of the primary sector is significantly higher than the national average. Specifically, in Murcia, it accounts for 5.4% of gross value added and 10.2% of employment, whilst in Almería it represents 13.1% of added value and 19.6% of employment, compared with 2.6% and 4.2%, respectively, for Spain as a whole. By contrast, the contribution of the primary sector in the province of Alicante is less than the national average (1.6% in terms of value added and 2.9% in terms of employment).

Table 5. Weight of gross value added (GAV) and employment by the agriculture, livestock, forestry and fisheries sector over the economy as a whole (2010): For Spain and the provinces affected by the aqueduct

GVA (€ in thousands)	Alicante	Murcia	Almería	National TOTAL
Agriculture, livestock, forestry and fisheries	485,907	1,379,447	1,495,821	24,554,000
Total GAV	31,295,567	25,435,016	11,416,579	957,771,000
% agriculture & others / Total GAV	**1.6%**	**5.4%**	**13.1%**	**2.6%**

Employment (thousands of people)	Alicante	Murcia	Almería	National TOTAL
Agriculture, livestock, forestry and fisheries	18.6	56.6	49.7	786.1
Total employment	636.1	557.4	253.3	18,855.5
% agriculture & others / Total employment	**2.9%**	**10.2%**	**19.6%**	**4.2%**

Source: INE.

Table 6 shows the weight of the provinces affected by the aqueduct, over Spain's total foreign trade of fruit and vegetable products. The figures show that Alicante, Murcia and Almería account for more than 35% [12] of the exports of these kinds of products from Spain, whilst the contribution of this sector to the balance of trade surplus is around 60%.

[12] ICEX offers more detailed information by individual fruit and vegetable product. The weight of the provinces affected by the aqueduct in terms of fresh vegetables and legumes increases to 72.1% in terms of exports and 85.5% in terms of the balance of trade surplus (data as at 2012).

2. The aqueduct and agriculture in the context of the regional and national economy

Table 6. Weight of provinces affected by the aqueduct, over Spain's total foreign trade of fruit and vegetables (2010-12)

2010	Exports	Imports	Balance
Alicante	573,494.5	207,306.4	366,188.1
Murcia	1,985,072.4	543,885.5	1,441,186.8
Almería	1,708,215.3	98,074.5	1,610,140.8
TOTAL Spain	11,834,933.4	5,818,095.4	6,016,838.0
Affected provinces %	**36.1%**	**14.6%**	**56.8%**

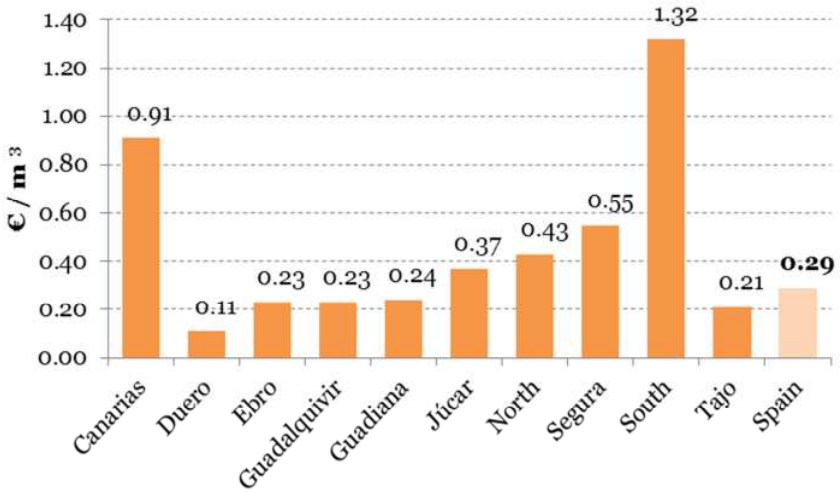
2011	Exports	Imports	Balance
Alicante	567,619.7	236,447.2	331,172.6
Murcia	2,002,491.4	598,431.0	1,404,060.5
Almería	1,745,063.7	98,440.9	1,646,622.9
TOTAL Spain	12,230,126.1	6,287,799.9	5,942,326.2
Affected provinces %	**35.3%**	**14.8%**	**56.9%**

2012	Exports	Imports	Balance
Alicante	739,657.3	236,444.3	503,212.9
Murcia	2,269,126.4	699,730.7	1,569,395.7
Almería	1,914,112.1	118,612.3	1,795,499.9
TOTAL Spain	13,469,752.4	6,953,784.6	6,515,967.8
Affected provinces %	**36.5%**	**15.2%**	**59.4%**

NOTE: ICEX's statistics include exports and imports of fresh, frozen and processed (canned food, jams, juices, etc.) products within the category of fruit and vegetable products.
Source: ICEX.

Finally, Figure 2 shows the net average margin by cubic metre of water consumed by the irrigation systems in the Segura Basin, compared with those located in other Spanish river basins. The net average margin data has been obtained from a study performed by MAGRAMA (then the Ministry for the Environment and Rural and Marine Affairs) in 2009, which in turn cites data from the Agricultural Statistics Yearbook (the 1998-2002 series), published by the Ministry. We highlight that these average figures are reported at a very aggregated level, the crop yield may vary significantly from one farm to the next within the same basis, and are out-dated. Nevertheless, the figures show that the crop yield in the Segura River Basin is much higher than the Spanish average (€0.55/m3 versus €0.29/m3) and is only surpassed by basins in the Canary Islands (€0.91/m3) and Southern-Andalucía (€1.32/m3). This is indicative of the fact that the products that are grown in the Segura River Basin have a high added value component and/or use the water in that basin very efficiently.

Figure 2. Net average margins of the irrigation systems used in the Segura River Basin compared with those located in other basins (1998-2002)



Source: MAGRAMA.

The study prepared by Calatrava and Martínez (2012) reported that the crops in the Segura River Basin yielded the highest returns. Specifically, the average amounted to €0.81/m3. In certain areas, such as in Mazarrón, Águilas and Almería, the average margin went up as high as €1.64/m3.[13]

The next section of this report contains an in-depth analysis and sizing of the agricultural sector in the region affected by the aqueduct. However, the data presented in this section clearly indicates that agriculture is a very important sector for the regional economy of the area and contributes very significantly (it accounts for around 60%) of Spain's positive balance of trade surplus for these kinds of products. Meanwhile, the margin information shows that the crops in the region affected by the aqueduct have a high added value component with respect to the volume of water consumed.

Overall, this data shows that a significant part of the region affected by the aqueduct relies heavily on the agricultural sector for economic purposes, and the provinces that receive water also make a greater relative contribution to a sector that, as we have seen above, is strategic for the national economy.

[13] Calatrava and Martínez (2012), p. 20. The data is calculated on the basis of gross water volumes. If we consider net volumes, the average for the Segura River Basin would be €0.95/m3 and the maximum would be €1.76/m3.

Measurement of the economic activities linked to agriculture in the region affected by the aqueduct

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3. Measurement of the economic activities linked to agriculture in the region affected by the aqueduct

In this section, we seek to measure the economic activities linked to agriculture that are dependent on the water supplied by the Tajo-Segura aqueduct. The measurement is calculated in terms of gross value added (as an indicator of contribution to GDP) and employment. In accordance with our comments in the introduction to this report, when performing the measurement, we have taken into account not only the farming operations supplied by transported water, but also the impact of other economic activities that form part of the value chain of the agri-food sector, and in particular:

- the marketing of agricultural products carried out by agricultural companies and cooperatives; and
- the processing of agricultural products, including the processing and preserving of fruit and vegetables, and the manufacture of processed fruit and vegetable products (juices, soups).

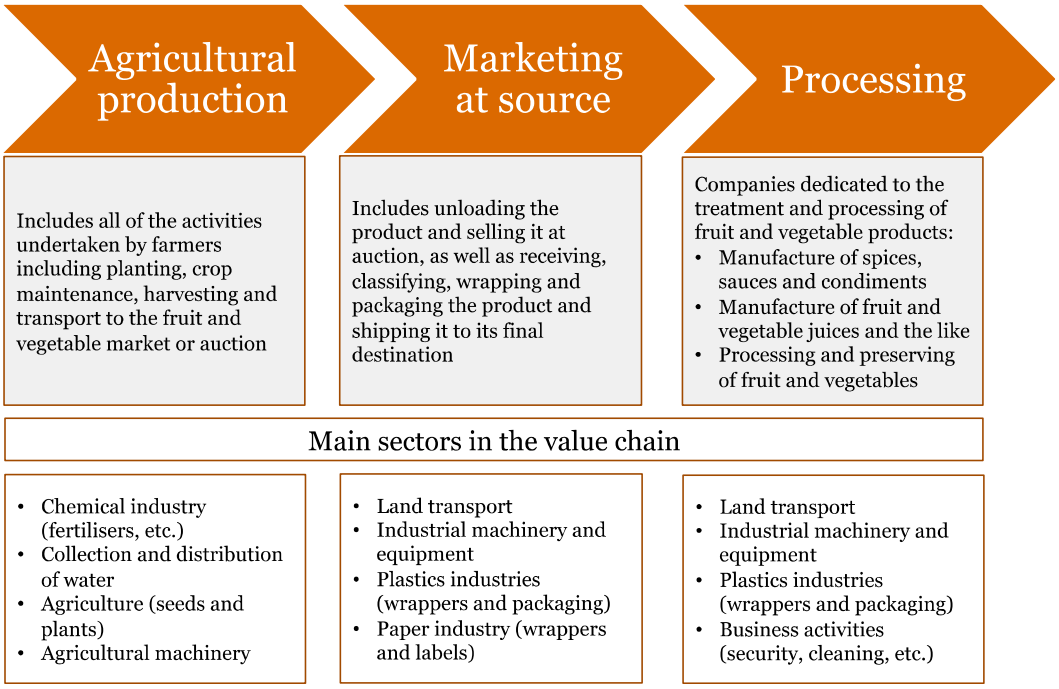
Moreover, and also when measuring the contribution made by each one of these activities, we have taken into account the direct impacts, that is, the gross value added and employment generated by the activities themselves, as well as the indirect and induced impacts.

The indirect impact corresponds to the carry-over effect that any activity has on its supply chain. Thus, for example, the supply chain for the agriculture sector includes industries such as agricultural machinery and chemical products (fertilisers and pesticides), amongst others. In this regard, our measurement of the impact includes the part of gross value added and employment in these supplier sectors that depend on the agriculture that is supplied by transported water. Figure 3 shows a diagram depicting the value chain in the agri-food sector, along with some of the activities that form part of that supply chain.

The induced impact corresponds to economic activity that is generated thanks to consumption by households that, to a greater or lesser extent, obtain their income from activities relating to the aqueduct. Thus, for example, in a region in which the main economic activity is agriculture, we would expect that a significant part of household consumption is financed using income (salaries and profit margins) from that activity and, as a result, traders and the provisions of private and public services will ultimately depend on agriculture to a large extent. Our estimation of the impact also includes the part of gross value added and employment of those sectors that supply goods and services that depend on the agriculture that is supplied using transported water.

The remainder of this section is dedicated to the presentation of our estimates of the gross value added and employment generated by the agri-food activities linked to transported water. These estimates are disclosed separately for agriculture, marketing and processing. At the end of the section, we include a summary of the findings obtained and an analysis of the sensitivities, which aims to calculate the impact of any variation in the volume of transported water on the agricultural sector in the regions affected by the aqueduct.

Figure 3. Value chain of the agri-food sector



Source: Compiled by the author

3.1. Agriculture

In this sub-section, we present our estimates about the size, in terms of gross value added and employment, of the agricultural activity carried out in the regions affected by the aqueduct, which is understood to comprise 61 municipalities, located in the areas irrigated using water from the aqueduct (refer to Annex B).

We have adopted an essentially quantitative approach for our analysis. Nevertheless, previous studies have assessed the impact of the aqueduct on agriculture from a more historical and qualitative perspective.[14] Those studies indicate, firstly, that the aqueduct, and the resulting increase in available water resources, has led to a gradual change in the types of crops grown, and has given rise to new varieties of vegetables, citrus fruits and orchard fruits, etc.

The implementation of the aqueduct has been accompanied by an intense period of modernisation and automation, which means that the area affected by the aqueduct is now one of the most important regions in Europe in terms of technological development. For example, according to data from MAGRAMA for 2012, 80% of the irrigation in the region affected by the aqueduct uses localised irrigation systems, resulting in better use of the water resources than from other systems, such as irrigation by gravity, sprinklers or automobile.[15] This data contrasts with the average figures for Spain as a whole, which show that less than 50% (46.3%) of the country's irrigation systems are localised. Furthermore, new cultivation techniques have been developed, including greenhouses with industrial operating systems and facilities equipped with cogeneration energy supplies.

[14] SCRATS (2005), *Report about the impact of the 2004/05 drought on irrigation using water transported by the Tajo-Segura aqueduct*.

[15] Localised irrigation (including by drip, by watering tubes and by micro-sprinkling) involves applying water to one part of the land only, using small, low-pressure flows. According to MAGRAMA, these irrigation systems use between 40% and 60% less water than other irrigation systems.

The widespread implementation of high-tech irrigation systems in the region affected by the aqueduct has facilitated the development of local companies, which now market their technology and components around the world. The case of valve systems manufactured in the Region of Murcia is particularly noteworthy for example. These systems allow the volume of water required for each operation to be controlled automatically. Another example is the case of the companies in the Region of Murcia that have developed the software and hardware necessary to control the automated processes of an agricultural facility (climate control, fertirrigation,[16] irrigation systems, etc.). A final example is that of the various engineering firms in Murcia that design turnkey projects, which integrate all of the automated processes from a farm into a single IT system that may be controlled from a computer or mobile phone.[17]

Below, we present our estimates of the economic activity linked to agriculture in the region. We also describe the methodology and assumptions used in the calculation.

Methodology and assumptions

Prior to determining the contribution to GDP (approximated on the basis of gross value added) and employment of the agricultural activities linked to the aqueduct, we have estimated the production value that results from these activities.

The production value roughly corresponds to the income generated from the sale of the various fruit and vegetable products. We have calculated this figure using data about the surface area eligible for irrigation using transported water, which has been broken down by geographic region and crop type. [18] According to the data provided by SCRATS, this surface area amounts to 147,276 on aggregate, of which 58,878 ha is located in the province of Alicante.[19]

The Segura River Hydrographic Confederation published more recent data in this regard indicating that this surface area amounted to 132,723 ha in 2009,[20] however that figure was not broken down by crop type. In any case, the surface area data provided by SCRATS for Alicante has been adjusted to take into account information provided by the Ministry for Agriculture for the Community of Valencia for certain crops, in such a way that, in the end, the irrigable area that has been taken into consideration for our analysis covers 127,278 ha (a smaller figure than reported by the Confederation).[21]

Subsequently, this surface area data has been multiplied by the average productivity of each crop group in the various provinces,[22] and by the corresponding average price. Specifically, the average productivity and price data used in the calculation have been the following:

- Average productivity. Corresponds to the average production volume by irrigable hectare (mt/ha) during the period 2007-2011, broken down by crop group and province.[23]

[16] Technology to accurately dispense water for irrigation, as well as fertilisers.

[17] Institute for Development in the Region of Murcia (2013), *The Agricultural Technology Sector in the R. of Murcia*.

[18] Refer to details in Annex C. Source: SCRATS.

[19] Levante irrigation area, left and right bank. Vegas Bajas del Segura and Alicante salt marshes.

[20] This data is found in the *Proposal for granting concessions for the priority use of water transported by the Tajo-Segura aqueduct*.

[21] For certain crop groups, the figures provided by SCRATS exceed the totals provided by the Ministry for Agriculture for the Community of Valencia for the province as a whole. In the end, the data used for Alicate correspond to the sum of the irrigable areas in the regions of Alicante that receive water from the aqueduct (Baix Segura and Baix Vinapló), according to data from the Ministry. Specifially, we have taken the following surface areas as the benchmark: (i) vegetables (including greenhouse crops): 6,972 ha; (ii) citrus fruits: 23,995 ha; (iii) orchard fruits (including other non-woody crops): 3,178 ha; (iv) almond trees: 3,652 ha; (v) olive trees: 0 ha; (vi) vine arbours: 803 ha; (vii) fallow land: 281 ha. Based on conversations we have helf with SCRATS and communities of farmers, we understand that "other non-woody crops" mainly include fruit trees (pomegranate, loquat and similar).

[22] Considering the following crop groups: vegetables, citrus, orchard fruits, almonds, olive trees, vines & woody trees.

[23] Figures calculated on the basis of annual production and irrigable surface area data for Murcia, Alicante and Almería. These figures have been obtained from the Autonomous Community for the Region of Murcia, the Ministry of Agriculture for the Community of Valencia and the Ministry of Agriculture, Fisheries and the Environment for Andalucía. The resulting average productivity ratios are presented in Annex C.

- Average price (in €/kg) during the period 2007-2011 for each crop group. Calculated on the basis of disaggregated data for the main products in the Region of Murcia.[24] The average price of each crop group has been calculated by weighing the price of each product by its production volume in the provinces affected by the aqueduct during the period under analysis.

In the case of productivity and average prices, we have chosen to consider the average figures over a period of 5 years, given the fluctuations that both variables are susceptible to from one year to the next. Therefore, the estimated contribution in our study does not refer to a specific year, but rather should be understood as an average or as a calculation for a representative average year.

In all cases, the average prices used for the estimate include the costs of harvesting and transporting the products from the farm to the trader at source or to the buyer's warehouse. For those cases in which the price obtained from the original data source did not include the cost of harvest or transport, or excluded one of those costs (for example, in the case of certain vegetables, citrus fruits, orchard fruits, olives and vines),[25] we have added these costs separately, taking the average unit costs for each crop group according to MAGRAMA and the questionnaires completed by the farmers and traders as a benchmark.[26]

The direct contribution to GDP[27] has been obtained by adding wages and salaries to the profit margin before interest and tax (EBIT) generated by agriculture in the region affected by the aqueduct. These two indicators have been estimated by applying the weights of the wages and salaries, and the EBIT margin by crop type, shown in the table below, and sourced from MAGRAMA [28], to the agricultural production value, calculated in accordance with the methodology described above.

Table 7. % of wages & salaries and profit margin over production value by crop group

	Vegetables	Citrus	Orchard	Almond	Olive	Vine
Wages & salaries	21.4%	15.4%	21.7%	22.5%	8.9%	8.3%
EBIT margin	34.4%	12.4%	18.5%	36.3%	19.7%	18.5%
TOTAL GVA	**55.8%**	**27.8%**	**40.2%**	**58.8%**	**28.5%**	**26.8%**

Source: MAGRAMA, Technical-Economic Results of Fruit and Vegetable Farms in the Region of Murcia in 2009; Technical-Economic Results of Fruit and Vegetable Farms in the Community of Valencia in 2009; and Technical-Economic Results of Agricultural Farms in Aragon in 2008.

[24] The price data for the main products has been obtained from the Autonomous Community for the Region of Murcia and is presented in Annex C. The products for which prices were not available for the Region of Murcia accounted for only 10% of the total production of the provinces affected by the aqueduct. In those cases, we have used average prices for Spain as a whole as published by MAGRAMA.

[25] Prices obtained from the original information source belong to one of the following three categories or trading positions: (i) the on-tree, on-farm or on-vine price, which does not include harvest or transport costs; (ii) farmer warehouse price, which includes the cost of harvesting the product but not the cost of transport; and (iii) source market price, which includes both the price of harvesting the product and the cost of transport.

[26] We have considered the following average harvesting costs: Vegetables €0.070/kg, Citrus fruits €0.072/kg, Orchard fruits €0.11/kg. In terms of average transport costs, we have considered the following: Vegetables €0.016/kg, Citrus fruits €0.013/kg, Orchard fruits €0.018/kg.

[27] The Gross Domestic Product or GDP is the standard indicator of economic activity and of the wealth generated by a country or region. Broadly speaking, it is equivalent to the sum of the gross added value (GAV) generated by the various sectors or an economy. GAV includes the cost of wages and salaries, sector profits and taxes paid to the administration.

[28] The weight of the EBIT margin has been calculated as the average for the period 2005-2009. The weight of wages and salaries relates to data for 2009. The original data was broken down by product (broccoli, lettuce, artichoke, watermelon, melon, greenhouse tomatoes, greenhouse peppers, orange, lemon, plum, apricot, peach, nectarine, pear, dry almond, olive, vine). The weight for each crop group has been calculated as the average of the weights for the most representative products. MAGRAMA does not provide data for olives or vines in the Region of Murcia, and so the weights presented for these crop groups correspond to data provided for the Community of Valencia and Aragon, respectively.

With regards to the direct impact on employment, we have estimated the average number of full-time workers employed in agriculture in the municipalities irrigated using water from the aqueduct in 2012. This estimate has been performed using information about monthly Social Security contributions, considering both the General Scheme of the Special Agricultural System (employed workers), as well as the Special System for Self-Employed Workers (self-employed farmers), and calculating the average for 2012. The Social Security data includes both agriculture and livestock workers. In order to strip out workers in the livestock segment, we have applied an adjustment coefficient equivalent to the weight of agriculture over the total UWA (Units of Work per Year) for agriculture and livestock in the region affected by the aqueduct.[29]

We have quantified the indirect and induced impact in terms of GDP using a standard methodology. Specifically, we have approximated the farmers' most direct supply chain using a breakdown of the main costs for each crop group.[30,31] The remainder of the agricultural supply chain has been measured using an Input-Output model, based on data from Spain's National Accounting register.[32]

Similarly, we have estimated the indirect and induced impacts of employment using the Input-Output model. Broadly speaking, these figures represent the jobs needed to handle the economic activity estimated above for each sector.

Contribution to GDP

Table 8 shows our estimates of the agricultural production value in the region affected by the aqueduct, broken down by crop group and recipient province. The aggregate production value amounts to €1,268 million per annum.[33] Most of the value corresponds to vegetables, which have higher productivity levels per hectare and average price than other crop groups.[34]

By area, the Region of Murcia accounts for 70% of the production value, due to its larger irrigable area (85,397 ha versus 58,878 ha in Alicante[35] and 3,000 ha in Almería) and the prevalence of vegetables – which, as we have seen, are characterised by higher productivity levels and prices – in the region.

[29] Figures obtained from the 2009 Agricultural Census compiled by Spain's National Institute of Statistics. The AWU data is broken down by municipality and therefore we can identify the region affected by the aqueduct.

[30] The original cost data was broken down by product. The breakdown of costs for each crop group corresponds to an average of the figures available for the most representative products. The data refers to the Region of Murcia in 2009 in all cases and has been sourced from the report "Technical-economic results of fruit and vegetable operations in the Region of Murcia in 2009" compiled by MAGRAMA. The data has been crosschecked with information obtained from the questionnaires sent to farmers. Annex D contains a breakdown of the costs considered for each crop group.

[31] The total operating cost amount corresponds to the figure for the estimated production value above, after deducting the weight of wages and salaries and the EBIT margin.

[32] Specifically, the most recent symmetrical Input-Output tables for Spain, which correspond to 2005. Annex E contains further details about the Input-Output model.

[33] This estimate is consistent with those obtained from previous studies. In this way, Melgarejo and Martínez (2009) estimated that the production value of crops cultivated in the region irrigated using water from the aqueduct amounted to €1,040.3 million. Meanwhile, Villar (2009) reported that annual income (equivalent to production value) in the region irrigated using water from the aqueduct amounted to €1,139.9 million. Finally, MAGRAMA (2009) quantified that the agricultural production value obtained using water from the aqueduct amounted to €744 million in 2008. Unlike the first two studies, which quantified the production value in the region affected by the aqueduct (which also uses other types of water and not just water sourced from the aqueduct), MAGRAMA's report calculates the production value generated exclusively using water from the aqueduct, assuming a transported volume of 400 hm^3/year.

[34] Refer to Annex C for more information.

[35] Irrigable surface area using water from the aqueduct in the province of Alicante, in accordance to the information provided by SCRATS. As stated above, we have considered a smaller surface area (38,560 ha) in our calculations.

Table 8. Agricultural production value of the region affected by the aqueduct (€ in millions, 2012)

	Murcia	Alicante	Almería	TOTAL
Vegetables (1)	549.5	115.2	47.9	712.5
Citrus fruits	131.3	160.1	9.6	301.0
Orchard fruits	204.1	22.6	0.4	227.1
Almonds	1.3	8.9	0.0	10.2
Olives	0.6	0.0	0.4	1.0
Vine arbours	12.7	3.9	0.0	16.6
TOTAL	**899.4**	**310.7**	**58.3**	**1,268.4**

NOTE: (1) Includes greenhouse crops.

Source: MAGRAMA, SCRATS, Autonomous Community of the Region of Murcia and figures compiled by the author.

Table 9 shows the contribution to GDP made by agriculture in the region affected by the aqueduct, broken down by type of impact (direct, indirect and induced). The global contribution to GDP is €1,286 million per annum, which represented 2.8% of aggregate GDP in the Region of Murcia and Alicante in 2010.[36] From that total, the direct impact generated by the agricultural activity itself accounted for 45% (€583 million), which represents around 30% of the agricultural GVA in Murcia and Alicante.[37]. This impact is generated entirely within the region affected by the aqueduct.

Meanwhile, the indirect or carry-over impact on the supply chain amounts to €147 million, whilst the induced impact is €256 million.[38] Given that for the calculation of the indirect and induced effects we have used the Input-Output tables for Spain, these impacts do not necessarily occur in the region affected by the aqueduct, but rather refer to Spain as a whole. Nevertheless, and given the local nature of many of the suppliers,[39] it seems reasonable to assume that a significant percentage of these impacts are concentrated in the region affected by the aqueduct itself.

Table 9. Contribution made by agriculture to GDP in the region affected by the aqueduct

Impacts	€ in millions, 2012
Direct	583
Indirect	447
Induced	256
TOTAL	**1,286**

Source: MAGRAMA, SCRATS, INE and figures compiled by the author.

[36] Excluding Almería, given the lower weight of the areas affected by the aqueduct in that province.

[37] The agrarian sector includes livestock, fisheries and agriculture. No other, more detailed GDP figures are published.

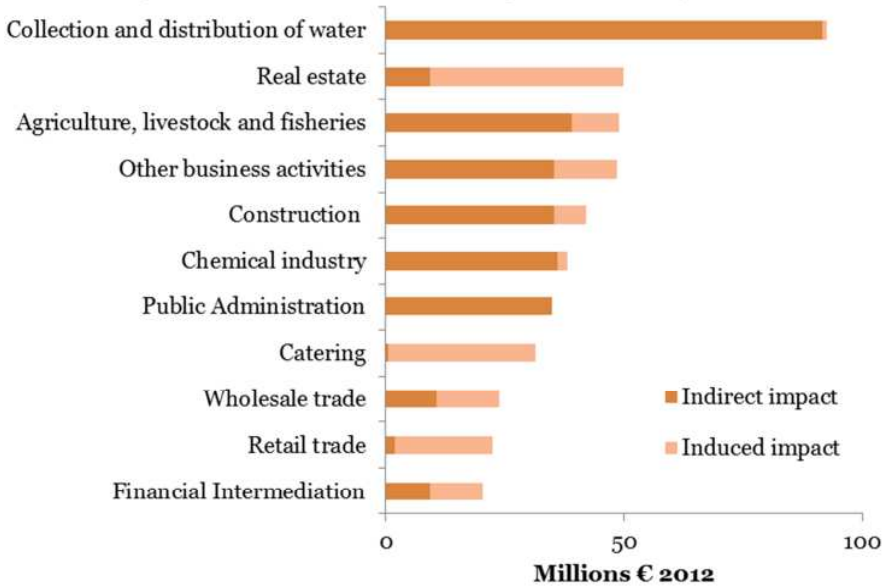
[38] To estimate the induced impacts, we assume that both the wages & salaries and the profit margins obtained by farmers are reinvested in the economy through increased consumption.

[39] As we have seen, the growth in agriculture in the region affected by the aqueduct has led to the implementation and development of much of the farmers' supply chain at the local level (transport, packaging, graphic art, pesticides, greenhouses, irrigation systems, agricultural and industrial machinery, food additives, etc.). Similarly, a substantial amount of household consumption is allocated to local suppliers (traders, restaurants, leisure and entertainment, water supply, etc.).

Figure 4 shows the indirect and induced impacts on GDP, broken down by sector. The sector for the collection and distribution of water is the main beneficiary, as a result of the spending made by farmers on water for irrigation (refer to breakdown of costs by crop group in Annex D). Other beneficiary sectors include agriculture (the purchase of seeds and plants), construction (facility maintenance and improvement works) and the chemical industry (fertilisers and pesticides).

Other sectors, such as real estate, other business activities (security, cleaning and advisory services, etc.), wholesale and retail, catering, form part either of the farmers' value chain or of the sectors that supply the goods and services required for the activity, or they benefit in an induced way (through household spending).

Figure 4. Indirect and induced impacts on GDP by sector



Source: INE, MAGRAMA and figures compiled by the author.

Contribution to employment

Table 10 shows the number of people registered in the agricultural sector in the region affected by the aqueduct for Social Security purposes. It also shows the total number of people registered in the agricultural sector in the provinces of Alicante, Murcia and Almería, and the percentage that the region affected by the aqueduct represents over the provincial total. All of the figures presented in the table are monthly averages relating to 2012. We can see that in 2012, the agricultural sector generated 58,632 jobs in the region affected by the aqueduct, of which 52,675 were employed workers and 5,957 were self-employed. We can also see that the region affected by the aqueduct accounted for 38.8% of all employment in the agricultural sector in Alicante, Murcia and Almería.[40]

[40] The provincial figures for the number of people registered in the agricultural sector for Social Security purposes include not only those employed in agriculture, but also those employed in livestock. The weight of the region affected by the aqueduct over the total number of people employed in the agricultural sector in the provinces of Alicante, Murcia and Almería is therefore higher in reality.

Table 10. Number of people registered for Social Security purposes in the provinces and region affected by the aqueduct

	# of people registered in the agricultural sector for SS purposes, by province	# of people registered in the agricultural sector for SS purposes, in the region affected by the aqueduct	% aqueduct region
Alicante	20,583	10,034	48.7%
Murcia	70,693	44,608	63.1%
Almería	59,932	3,990	6.7%
TOTAL	**151,208**	**58,632**	**38.8%**

Source: Social Security, INE and figures compiled by the author.

Table 11 shows the indirect and induced jobs linked to agricultural activities that are undertaken in the region affected by the aqueduct, which, based on our estimates, amount to almost 15,0000 (in terms of full-time equivalents or FTEs[41]). Just like in the case of the impact on GDP, our estimates regarding indirect and induced employment refer to Spain as a whole, however it is reasonable to assume that a significant portion corresponds to the region affected by the aqueduct.

Table 11. Indirect and induced impacts on employment

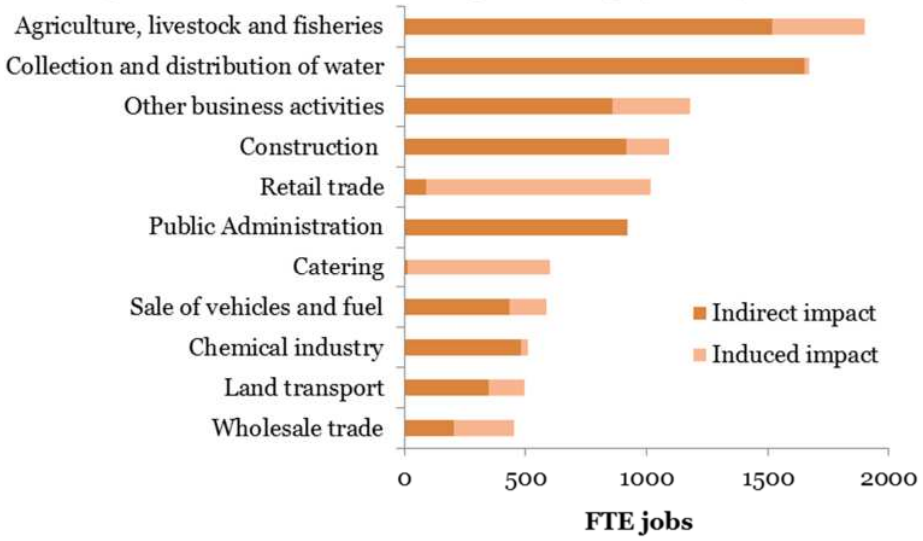
Impacts	FTE Jobs
Indirect	9,525
Induced	5,453
TOTAL	**14,978**

Source: MAGRAMA, SCRATS, INE and figures compiled by the author.

Figure 5 shows the breakdown of the direct and indirect jobs generated by sector. In general terms, there is a certain degree of correlation between the sectors that benefit the most in terms of GDP and employment. Nevertheless, some divergences do arise, driven by differences between sectors in terms of labour productivity, amongst other factors. Thus, sectors that are very labour-intensive, such as agriculture, livestock and hunting (1,900 FTE jobs), construction (1,093 FTE jobs), retail (1,015 FTE jobs), catering (599 FTE jobs) and the sale and repair of vehicles and the sale of fuel (584 FTE jobs) have relatively high impacts in terms of employment with respect to their impacts on GDP. The sector that involves the collection, purification and distribution of water generates 1,669 FTE jobs and is whereby the second largest sector in terms of number of jobs, most of which are created indirectly; it is followed by the other business activities sector, with 1,179 FTE jobs.

[41] *Full time equivalent.*

Figure 5. Indirect and induced impacts on employment by sector



Source: INE, MAGRAMA and figures compiled by the author.

Overall, considering the direct, indirect and induced impacts, the agricultural generates 73,610 jobs in total in the region that receives water from the aqueduct, based on our estimates.

3.2. Marketing and distribution

As we saw in the previous sub-section, we have defined agriculture to include all of the activities that are undertaken until the products arrive at the fruit and vegetable centres. From that point, the next stage in the value chain begins, namely that of marketing and distribution. This stage, in turn, comprises the following activities:

- Receiving the product, including unloading, weighing and initial quality control testing.
- Storage, selection, preparation, wrapping, packaging and labelling of the product.
- Quality control. Before sale, checks are performed to ensure that the product complies with the specifications established by the fruit and vegetable centre and by the client.
- Palletizing-storage. Merchandise is palleted, and placed in cold storage until shipment.
- Order management and delivery to wholesalers, including, where appropriate, transport to the end destination.

Fruit and vegetable centres adopt very varied structures, although the majority are organised as companies, cooperatives or agricultural processing companies (SAT). They vary in size, both in terms of turnover, as well as number of partners.

Some centres have exclusive distribution agreements for their products with the establishments of large, international retail groups, and whereby avoid the need for subsequent marketing through wholesalers on arrival.

Methodology and assumptions

We have started using a calculation of the unit cost amount and the value added over the price paid to the farmer at this stage of the chain. This calculation is based on figures published by MAGRAMA in its Food Price Observatory, regarding the amount and structure of marketing costs for different agricultural products. [42] The information sourced from MAGRAMA has been crosschecked against data obtained from the questionnaires completed by traders.

The unit amount calculated includes all of the costs incurred during the marketing stage, including personnel expenses, and the margins earned by traders. It is calculated as the difference between the sales price recorded by the fruit and vegetable centres, and the price paid to farmers. [43] Table 12 shows the unit amounts that have been considered for each crop group.

Table 12. Unit cost and value added at the marketing stage by crop group

€ 2012/kg	Vegetables	Citrus fruits	Orchard fruits
Marketing costs	0.58	0.34	0.41

Source: MAGRAMA, "Food price observatory", questionnaires sent to traders and figures compiled by the author.

If we apply the unit amounts above to the agricultural production volume in the region affected by the aqueduct, after deducting the losses for each crop group,[44] then we obtain the value added to production during the marketing stage. The direct impact on GDP has been calculated by multiplying the aforementioned figure to the average weight of the wages and salaries and the EBIT margin by crop group, which are presented in the following table.[45]

Table 13. Weight of wages and salaries and margin over total unit cost and value added during the marketing stage

	Vegetables	Citrus fruits	Orchard fruits
Wages & salaries	37.1%	19.9%	23.5%
EBIT margin	15.6%	17.0%	11.3%
TOTAL GVA	**52.7%**	**36.9%**	**34.8%**

Source: MAGRAMA, Food price observatory (studies about the value chain and price setting), questionnaires sent to traders and figures compiled by the author.

[42] Specifically, peppers and tomatoes (vegetables), lemons, oranges and mandarins (citrus fruits), and pears and apples (orchard fruits). The unit cost and value added have been calculated for each crop group as the average of the prodcuts analysed. The impacts calculated in this phase only include the marketing of vegetables, citrus fruits and orchard fruits. Unlike in the agricultural production phase, here we do not include the impact of the marketing of almonds, grapes or olives, as no data is available about their cost structures. The crop groups not considered represent just 1% of the total agricultural production.

[43] The data from MAGRAMA include costs associated with wastage and marketing expenses (commissions and rappels) within marketing costs. For the purpose of our analysis, we have considered the sales price recorded by the fruit and vegetable centre, net of commercial costs. As we will see below, the cost of wastage, rather than being reflected in this price, has been taken into account by decreasing the volume of product acquired that is effectively sold by the trader.

[44] The wastage in this stage includes two different concepts: (i) the volume of production delivered by the farmer that goes to the processing industry, which is normally lower quality and therefore sold at a lower price; and (ii) the volume of production delivered by the farmer that is thrown away due to lack of quality. The average wastage percentages assumed for each crop group are: vegetables, 20%; citrus fruits, 22%; orchard fruits, 22%. These figures have been extracted from the report prepared by Ernst & Young and Capgemini in 2004 "Analysis of the value chain and price setting for fresh produce".

[45] Percentages calculated on the basis of figures from MAGRAMA's Food Price Observatory in 2008 and 2010 for vegetables, in 2010 for citrus fruits and in 2008 for orchard fruits.

Meanwhile, the direct impact on employment has been calculated by multiplying the production value at the traders' price, by the ratio of employees over sales that is considered representative for the activity. This ratio has been calculated as the quotient of the number of employees and the aggregate operating income of the companies, cooperatives and agricultural processing companies (SAT) located in the region affected by the aqueduct. The employee and income data for the various agents considered has been sourced from their annual accounts for 2011, available in SABI.[46]

The indirect and induced impacts on GDP and employment have again been calculated using the Input-Output model. To calculate them we had to first obtain a breakdown of the costs incurred during the marketing stage, by concept. The operating costs have been calculated by deducting the amount that corresponds to wages and salaries and the EBIT margin from the total value added to production during the marketing phase. The breakdown of the costs by crop group has been sourced from MAGRAMA (refer to Annex D).[47]

Contribution to GDP

Table 14 shows our estimates of the contribution made to GDP of the marketing activity in the region affected by the aqueduct. The total impact amounts to €875.6 million. From that total, €448 million corresponds to the direct effect, generated by the marketing activity itself; €288.4 million relates to the indirect effect carried over from the supply chain; and €138.4 million relates to the induced effect.

As in the case of agriculture, the indirect and induced effects are estimated for Spain as a whole, although it is reasonable to assume that a significant portion occurs in the region affected by the aqueduct.

Table 14. Contribution to GDP by marketing in the region affected by the aqueduct

Impacts	€ in millions 2012
Direct	448.8
Indirect	288.4
Induced	138.4
TOTAL	**875.6**

Source: MAGRAMA, SCRATS, INE and figures compiled by the author.

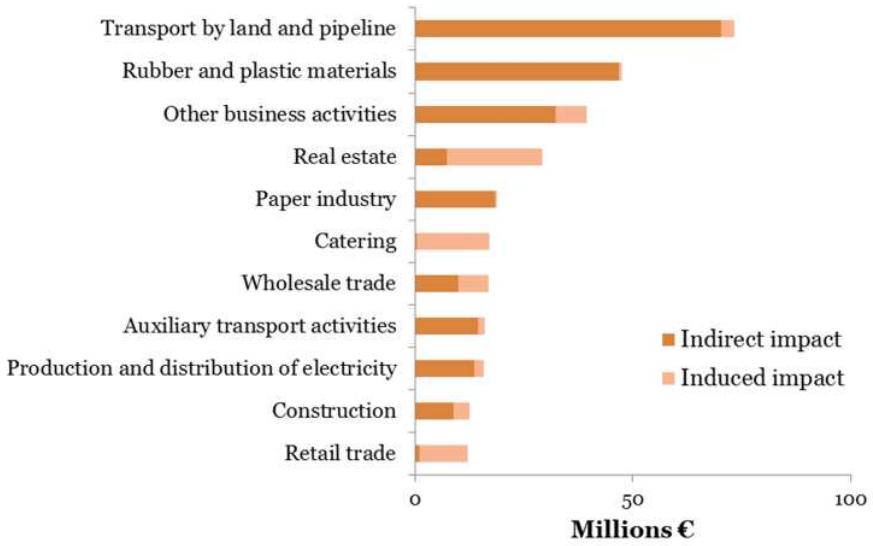
Figure 6 shows the indirect and induced impacts on GDP broken down by sector. The transport of products once they have been wrapped and packaged, and the acquisition of containers, packaging and labels are the most important cost items in the marketing stage. This explains why the sectors that have the greatest impact on GDP are land transport, rubber and plastics, and paper (other packaging and labels), which generate €73.3 million, €47.3 million and €18.7 million, respectively.

The sectors comprising other business activities (€39.4 million) and the production and distribution of electricity (€15.7 million) are mainly affected by the procurement of external services, such as advisors and security, and electricity consumption at the facilities associated with marketing. Finally, the real estate, catering and retail sectors are primarily affected in an induced way.

[46] Iberian Balance Sheets Analysis System. The ratio calculated based on information in the annual accounts has been crosschecked against data from Spain's National Accounting files relating to the wholesale sector.

[47] Breakdown of costs obtained on the basis of figures from MAGRAMA's Food Price Observatory. This breakdown has been crosschecked with information from the questionnaires sent to traders.

Figure 6. Indirect and induced impacts on GDP by affected sector



Source: MAGRAMA, SCRATS, INE and figures compiled by the author.

Contribution to employment

Table 15 shows our estimates of the direct, indirect and induced employment generated by marketing activating in the region affected by the aqueduct. In aggregate, we calculate that marketing supports 25,278 FTE jobs, of which more than 16,300 are direct and around 9,000 are indirect and induced.

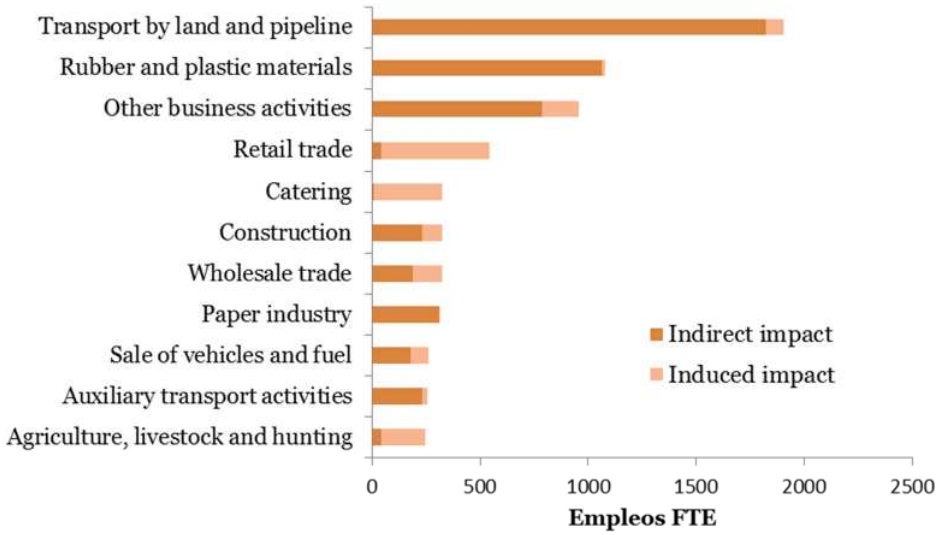
Table 15. Contribution to employment by marketing in the region affected by the aqueduct

Impacts	FTE Jobs
Direct	16,363
Indirect	5,962
Induced	2,953
TOTAL	**25,278**

Source: MAGRAMA, SCRATS, INE and figures compiled by the author.

Figure 7 shows the breakdown of jobs generated indirectly and induced by sector. Land transport (1,906 FTE jobs), rubber and plastics (1,077 FTE jobs) and other business activities (958 FTE jobs) are again the sectors that are most impacted by the marketing activity.

Figure 7. Direct and induced impact on employment by affected sector



Source: MAGRAMA, SCRATS, INE and figures compiled by the author.

3.3. Processing

Some of the largest fruit and vegetable processing companies in Spain are located in the region affected by the aqueduct. These include companies that are dedicated to the production of tinned food, fruits and vegetable juices and nectars, jams and compotes, pickles and olives, and sauces. According to the latest statistics available from INE's Companies Central Directory (DIRCE), 166 companies belonged to the sector for the processing and canning of fruits and vegetables in the Region of Murcia in 2012. Only Andalucía surpassed Murcia in this regard, with a total of 337 companies. The Community of Valencia was third in the ranking with 147 companies.

Annex F contains the list of the top 50 fruit and vegetable processing companies that have their headquarters in the provinces affected by the aqueduct. These include AMC, Hero and Juver, which are also amongst the top 5 companies in the sector in Spain, occupying the first, second and fifth positions in the ranking, respectively. Two of these companies, AMC and Juver, also have their headquarters located in municipalities that lie in the region affected by the aqueduct. [48] Other companies that feature near the top of the ranking of Spanish processing companies, and that are located in the region affected by the aqueduct, include Marín Montejano S.A., Fruveco S.A. and Golden Foods S.A. The box below includes a description of the activity undertaken by these companies.

[48] The ranking of processing companies in the provinces affected by the aqueduct and at a national level has been prepared using data from SABI. Companies that did not record any turnover information for the year 2010 or beyond have been excluded, with the exception of Hero.

Box 1 – Activities carried out by the main fruit and vegetable processing companies in the region affected by the aqueduct

AMC Grupo Alimentación, Fresco y Zumos S.A.

Company founded in 1931, headquartered in Murcia and dedicated to the production and export of fruits and citrus fruits, as well as the squeezing of fruits and packaging of juices. It is one of the 5 largest food companies in Spain by export volume. In 2011, it recorded operating income of more than €500 million and it has more than 1,700 employees and 3,000 associated farmers across Spain. The company has production facilities in Murcia and Valencia. Through its subsidiary companies, AMC exports and distributes its products throughout Europe (Spain, France, Portugal, Germany, Austria, Switzerland, UK, Poland, Ireland, Italy, Belgium, Holland, Luxembourg, Hungary, Slovakia and the Czech Republic), as well as in North America (USA and Canada). AMC has also established several strategic alliances with local producers in countries such as China, Argentina, South Africa and Australia.

Juver Alimentación S.L.

A Murcia-based company, created 47 years ago, whose main activities are the production of juices and nectars, functional beverages and canned fruit and vegetables. In 2011, the company recorded operating income of €150 million and had 370 employees. In 2003, Juver was sold by Hero (it had formed part of the group since 1990) to Conserve Italia (Europe's largest fruit and vegetable processing cooperative).

Marín Montejano S.A.

Company founded in 1958 and headquartered in Lorquí (Murcia). Its main activity is the manufacture and sale of canned fruits and vegetables, legumes, juices and nectars. Its products are distributed domestically and internationally, including to countries such as USA, Mexico, Cuba, Venezuela, Northern Africa, Asia, France, Portugal, Germany and countries in Eastern Europe. The Marín Montejano Group also includes the activity of the business Frucomur (Alguazas, Murcia), dedicated to the production of canned fruits and vegetables and jams; Frucopasa (Huesca), dedicated to the manufacture of canned fruit; and Agrotransa (Lorquí, Murcia), dedicated to the packaging of juices, nectars and other drinks. The Group's activity in the province of Murcia generated operating income of more than €100 million in 2010, employing almost 250 people.[49]

Fruveco S.A.

Company founded in 1986. It is dedicated to the manufacture and freezing of vegetables (artichokes, celery, aubergines, broccoli, courgettes, onions, cauliflowers, peppers, tomatoes and others). Its operating income exceeded €33 million in 2011. The company has a 23,900 m2 plant in El Raal, Murcia, which is equipped with 5 freezing tunnels with capacity for 31 mt of finished product per hour, 6 packaging lines with a capacity of 12 mt/hour, 7 production lines and 185,000 m2 of cold storage at -25ºC.

Golden Foods S.A.

Company founded in 1986 and located in Torres de Cotilla, Murcia. It is dedicated to the manufacture of high quality canned fruit and vegetables, under both its own brand as well as white label. Its annual production volume amounts to 30,000 tons. The company supplies a variety of products including artichokes, peppers, peaches, pears, grapes and fruit cocktails. It has more than 250 employees, and in 2011, it recorded operating income of more than €30 million.

Source: Companies' websites and SABI.

[49] Figures for 2011 extracted from SABI for Marín Montejano SA, Agrotransformados SA (AGROTANSA) and Frutas y Conservas de Murcia SL (FRUCOMUR).

Methodology and assumptions

To calculate the contribution made by the processing activity, we have started by using financial data from SABI relating to the companies that have their corporate headquarters in the provinces of Alicante, Murcia and Almería and that belong to one of the following sectors (CNAE 2009):

- Manufacture of spices, sauces and condiments;
- Manufacture of fruit and vegetable juices;
- Other processing and canning of fruit and vegetables.

The information obtained from SABI corresponds to the data filed by the companies in their annual accounts for 2011, and includes operating income, personnel expenses, margins (ordinary profit before tax) and the number of employees.

We have excluded companies that have filed for liquidation or that are extinct from the sample considered for our analysis. We have also excluded those companies that, although they fit within one of the sectors listed above, actually carry out activities other than those that form the subject of this study.[50] We have also identified the companies that, although they have their headquarters in provinces affected by the aqueduct, actually have one or more manufacturing or distribution centres located elsewhere. The financial and other indicators (operating income, personnel expenses and number of employees) relating to these companies have been adjusted down in order to estimate the impact generated exclusively in the region affected by the aqueduct.[51]

Finally, and again, in order to focus exclusively on the impact in the region affected by the aqueduct, we have adjusted the aggregate figures for turnover, personnel expenses and employment for all of the companies in the sample, using a ratio that measures the weight of the region affected by the aqueduct over the total of the provinces of Alicante, Murcia and Almería as a whole, in terms of irrigated farmland. [52] This adjustment has been performed on an individual basis for each province affected by the aqueduct.

The approach used for the calculation may be considered relatively conservative, given that it does not include the companies that did not file annual accounts in 2011, or those that did not register their accounts in SABI, and also given that the allocation of the region affected by the aqueduct has been calculated on the basis of hectares and not production volumes (when in reality, the crops in this region are characterised by a high level of productivity).

On the basis of the aforementioned adjusted figures, the direct impacts on GDP and employment of the processing activity has been calculated by adding together the personnel expenses and the margin, on the one hand, and the number of employees, on the other.

The indirect and induced impact on GDP and employment has again been calculated using the Input-Output model. The amount of operating costs has been calculated by subtracting the personnel expenses and margin figures from operating income. In addition, and in order to avoid any double counting of the impacts on agricultural marketing and processing, we have deducted the cost of raw material purchases from these operating costs.[53]

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[50] In this respect, we have conducted process to search for individual information about each company from public sources. Some of the companies excluded from our sample for example were Fripozo S.A., which, despite being classified within the "Other processing and canning of fruit and vegetables" sector, actually carries out other types of activities.

[51] We have made adjustments for 4 companies. In each case, the adjustments have been made on the basis of the information available for each company (the number of production or processing centres in the provinces affected by the aqueduct and beyond, and the number of employees in each one of the centres).

[52] Specifically, the ratio has been calculated considering the hectares that correspond to the following crop groups: vegetables, citrus fruits, orchard fruits, almonds, olives and vine arbours. The resulting ratios for each province affected by the aqueduct are as follows: Alicante, 37%; Murcia, 32%; Almería, 2%.

[53] The weight of raw material purchases has been estimated on the basis of information from the Input-Output tables, which show that, from the total expenditure made by the other food industries sector (which the fruit and vegetable processing companies fall into), 31% is spent in the agriculture, livestock and hunting sector.

The breakdown of costs necessary to approximate the most direct supply chain of the processing industry has been obtained from the Input-Output table. Specifically, we have assumed that the cost structure of the processing activity is similar to that observed for the "other food industries" sector in the Input-Output table.

Table 16 shows the size of the sample of the companies selected for each province affected by the aqueduct, as well as the main figures (operating income, personnel expenses and margin) after adjustments, following the procedure described above.

Table 16. Main adjusted figures for the processing activity in the region affected by the aqueduct

€ in thousands 2012	Alicante	Murcia	Almería
Number of companies	30	85	8
Operating income	58,182	275,419	3,465
Personnel expenses	3,868	29,836	124
Margin	12	6,167	118

Source: SABI, SCRATS and figures compiled by the author.

Contribution to GDP

Table 17 shows our estimates of the contribution to GDP of the processing activity in the region affected by the aqueduct. In aggregate, it amounts to €202 million, of which the majority (€133.6 million) corresponds to the indirect or carry-over effect on the supply chain.

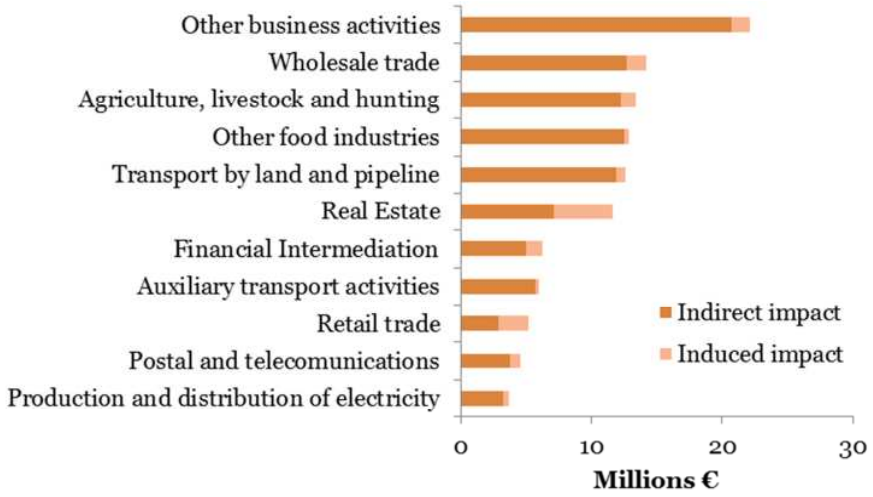
Table 17. Contribution to GDP of the processing activity in the region affected by the aqueduct

Impacts	€ in millions 2012
Direct	40.1
Indirect	133.6
Induced	28.5
TOTAL	**202.3**

Source: SABI, SCRATS, INE and figures compiled by the author.

Figure 8 shows the breakdown of the indirect and induced impacts on GDP by sector. The other business activities sector, which includes external services such as advisory, engineering, cleaning and security, benefits the most (€22.2 million). It is followed by the wholesale sector (€14.2 million), agriculture, livestock and hunting (€13.4 million), other food industries (€12.9 million) and land transport (€12.6 million). All of these sectors form part of the supply chain for the processing industry. Other sectors, such as real estate activities (€11.6 million) and retail (€5.1 million) are mainly affected in an induced way.

Figure 8. Indirect and induced impacts on GDP by sector



Source: SABI, SCRATS, INE and figures compiled by the author.

Contribution to employment

Table 18 shows the direct, indirect and induced contribution to employment, estimated for the processing activity. In total, the sector generates more than 5,000 FTE jobs, of which 1,344 people work directly in the processing companies themselves, 3,120 are created indirectly and 608 are induced.

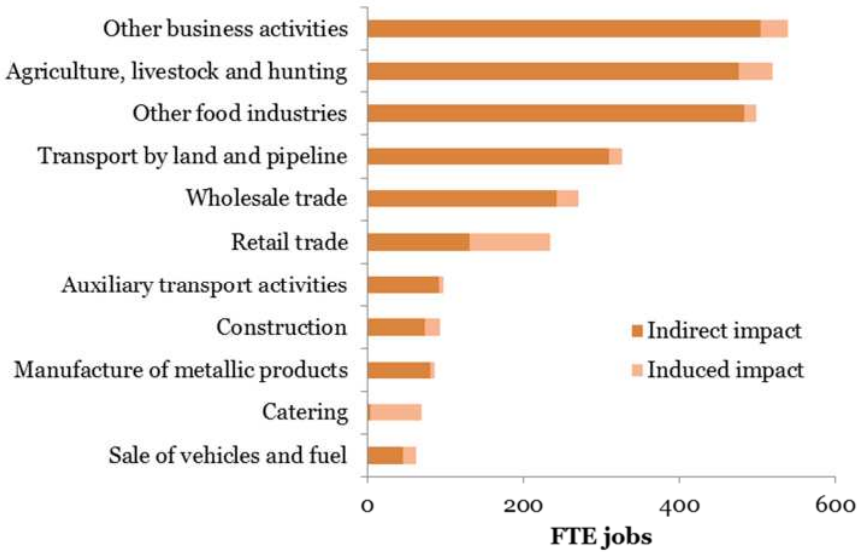
Table 18. Contribution to employment of the processing activity in the region affected by the aqueduct

Impacts	FTE Jobs
Direct	1,344
Indirect	3,120
Induced	608
TOTAL	**5,072**

Source: SABI, SCRATS, INE and figures compiled by the author.

Figure 9 shows the breakdown of indirect and induced jobs by sector. As was the case for GDP, the other business activities sector benefits the most with 530 FTE jobs, followed by agriculture, livestock and hunting, with 519 jobs and other food industries, with 518 jobs.

Figure 9. Indirect and induced impacts on employment by sector



Source: SABI, SCRATS, INE and figures compiled by the author.

3.4. Summary of our findings and sensitivity analysis

Table 19 summarises out estimates of the impact on GDP and employment of the activities linked to agriculture in the region affected by the aqueduct. The impact on GDP amounts to €2,364 million in aggregate, of which more than 50% corresponds to agriculture. As we have seen above, the impact of agriculture alone (€1,286 million) represents 2.8% of GDP in the Region of Murcia and Alicante as a whole. The total impact (including marketing and processing) accounts for more than 5% of GDP of these regions.

The contribution to employment exceeds 100,000 FTE jobs, of which more than 70% correspond to agriculture. The relatively higher weight of this activity on employment is due to the fact that it is more labour intensive than the marketing and processing industries.

Table 19. Estimates of the impact on GDP and employment: summary of our findings

	GDP (€'M 2012)	Jobs
Agriculture	1.286	73,610
Marketing	876	25,278
Processing	202	5,072
TOTAL	**2,364**	**103,961**

Source: INE, MAGRAMA, and figures compiled by the author.

We have performed a sensitivity analysis with the aim of assessing the impact of possible variations in the volume of water transported by the aqueduct. These variations may arise as a result of restrictions over the volume of water available at source, or due to increases in the price of water in the context of the increasing scarcity of the resource in the future.

3. Measurement of the economic activities linked to agriculture in the region affected by the aqueduct

The analysis has focused on estimating the sensitivity of agricultural production in the region affected by the aqueduct in the event of changes in the volume of transported water based on historical data. In particular, we have used annual data from MAGRAMA about agricultural production in Alicante and Murcia, [54] and the net consumption of water from the Tajo-Segura aqueduct for the years 1984 to 2011. Production is measured in terms of volumes (mt) and includes vegetables, citrus fruits, other fruits, table grapes and olives, only. Net water consumption is also measured by volume (hm^3). We have performed our analysis using aggregate data for the provinces affected by the aqueduct as a whole.

The sensitivity of production to the volume of water transported has been estimated by applying econometric techniques to the historical series analysed. Specifically, we have assumed that the relationship between agricultural production and the volume of transported water can be expressed by the following formula:

$$Q_t = \beta_0 + \beta_1 \times TRASV_t + \beta_2 \times Q_{t-1} + \varepsilon_t$$

where Q_t is the volume of agricultural production in the provinces of Alicante and Murcia as a whole in a given year (t), which, according to the model, would be due to: (i) the total net consumption of water from the aqueduct during that year ($TRASV_t$); (ii) the volume of agricultural production recorded in the previous year (Q_{t-1}); and (iii) a random error term (ε_t).

The coefficients β are the parameters that are estimated econometrically. They measure the relationship that exists between production and the variables that explain it according to the model (transported water and production in the previous year).[55]

The main advantage of the model used is that it allows us to estimate the impact of variations in the volume of water transported in both the short term and the medium-long term. We present the results of the econometric model in Annex G.

Table 20 shows the estimated sensitivities, which have been adjusted to reflect the impact of variations in the volume of transported water on agricultural production only in the region affected by the aqueduct. We can see that a 10% variation in the volume of transported water is likely to produce an immediate effect of around 1% of production. The effect over the medium-long term increases to 4.3%.

The fact that the impact on production is less than proportional to any variation in the volume of transported water is logical given that, on the one hand, such variations would most likely affect the least productive irrigated areas and that, on the other hand, alternative sources of water also exist. The values obtained are also in line with those estimated in previous academic studies.[56]

Table 20. Sensitivity of agricultural production in the region affected by the aqueduct to a 10% variation in the volume of transported water

	Elasticity
Short term	0.9903%
Long term	4.2727%

Source: MAGRAMA, and figures compiled by the author.

[54] We have excluded Almería as we are performing our analysis using aggregated data by province and because the area irrigated using water from the aqueduct has a lower relative weight in this province than in Murcia or Alicante.

[55] The model has been estimated using variables expressed in logarithms. The estimated coefficients are therefore interpreted as elasticities. For example, the coefficient β_1 measures the percentage variation in agricultural production that can be expected in the short term in the event of a 1% variation in the volume of water transported by the aqueduct.

[56] For example, Alcalá y Sancho (2002), in a study for the Region of Murcia, reported that the elasticity values typically considered for this king of analysis range between 0.5 and 1, which indicates that in the event of a 10% variation in the volume of water, production would vary by between 5% and 10%. Nevertheless, these values refer to the sensitivity in the event of variations in the total volume of water available (including not only water transferred by the aqueduct, but also water from other sources). Logically, the sensitivity of production to variations in the volume of water transferred by the aqueduct only should be lower due to the possible substitution effect of other sources of supply.

The tourism sector in the region affected by the aqueduct

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In this section, we analyse the importance of the tourism sector for Alicante, Murcia and Almería, in general, as well as for the region affected by the aqueduct, in particular. As we have seen, some of the transported water is used for domestic and industrial supply in municipalities that are important tourist destinations. From this perspective, the aqueduct may have also contributed to the development of the tourism sector in the region, by ensuring the supply of water and reducing the risk of restrictions and cuts in the supply during times of scarcity.

4.1. Tourism in the Region of Murcia and the Community of Valencia

Table 21 shows the weight of the tourism sector in the Autonomous Communities of Murcia and Valencia, and it compares this with the average for Spain, using data from Exceltur. [57] We have performed this analysis at the Autonomous Community level because no comparable figures were available at the provincial level. We have excluded Andalucía from the analysis, due to the lower weight that the area supplied with transported water has over the total of that Autonomous Community.

The figures show that tourism accounts for 9.8% of GDP in the Region of Murcia and 12.6% in the Community of Valencia, compared with the national average of 10.8%. [58] In the case of Murcia, tourism's contribution to GDP falls below the Spanish average, however its performance has followed a positive trend in recent years, up from 9.2% in 2010 to 9.8% in 2011, whereas the overall economy in the region remained stable during that period (GDP increased by just 0.01% between 2010 and 2011).

Table 21. Weight of the tourism sector over GDP in Murcia, Valencia and Spain (2011)

	Weight of the tourism sector over GDP
Region of Murcia	9.8%
Community of Valencia	12.6%
NATIONAL TOTAL	**10.8%**

Source: INE, Exceltur.

Table 22 contains figures about the number of employees that depend on the tourism sector in Region of Murcia and the Community of Valencia, as well as their weight over total employment in their respective regions, and compares them with the national average. The figures show that 10.2% of jobs in the Region of Murcia are generated by activities relating to tourism. That figure amounts to 13.4% in the Community of Valencia and 12.2% for Spain as a whole.

Table 22. Weight of the tourism sector over employment in Murcia, Valencia and Spain (2011)

Tourist sector:	Number of employees	% over total employment
Region of Murcia	55,792	10.2%
Community of Valencia	270,452	13.4%
NATIONAL TOTAL	**2,254,000**	**12.2%**

Source: INE, Exceltur.

[57] Non-profit making association currently comprising 24 Spanish tourism businesses representing the following sub-sectors: air, road, railway and sea transport, accommodation, travel agents and tour operators, payment methods, car hire companies, leisure companies, theme parks, tourist hospitals, large booking offices and time share companies, amongst others.

[58] Both these percentages, as well as the employment figures presented later in this report, include both the direct impacts (small businesses, hotels, restaurants, car hire, taxis, etc.), as well as indirect impacts (food and drink, construction, gas, electricity and water, maintenance, etc.).

Finally, Table 23 shows the number of overnight stays that were registered in tourist establishments in Alicante and Murcia in 2011. In aggregate, almost 28 million overnight stays were recorded, which represents just over 7% of the national total (389 million in 2011).

Table 23. Number of overnight stays in tourist establishments in Murcia and Alicante (2011)

	Hotels	Apartments	Campsites	Rural accommodation	TOTAL
Alicante	15,221,383	5,183,795	2,930,091	73,698	23,408,967
Murcia	2,692,911	680,996	1,125,893	73,652	4,573,452
TOTAL	**17,914,294**	**5,864,791**	**4,055,984**	**147,350**	**27,982,419**

Source: INE.

4.2. The water supply in tourist areas of Murcia and Alicante

As we have seen, most of the transported water used for domestic and industrial supply is managed by the MCT. Table 24 shows the weight of the regions supplied by the MCT over Alicante and Murcia as a whole, in terms of surface area, population and the number of people registered for Social Security purposes. [59]

The figures show that the MCT supplies almost all of the Region of Murcia and a substantial proportion of the population in Alicante. Thus, according to the available data, in the case of Murcia, 86% of the surface area and more than 95% of the population is supplied by the MCT. In the case of Alicante, those percentages are lower: 31% of the surface area and 57% of the population, since the Northern region of the province does not fall within the MCT's perimeter. The weight of the regions supplied by the MCT in terms of the number of people registered for Social Security purposes are similar to those obtained from the population data (95% in Murcia and 61% in Alicante).

[59] The data regarding the surface area and population supplied by the MCT has been obtained from the MCT itself, which in turn cites data from INE. The data regarding the number of people registered for Social Security purposes has been calculated by adding the information provided by Social Security for each one of the municipalities that is supplied with water from the MCT.

Table 24. Surface area, population and Social Security members supplied by the Mancomunidad de Canales del Taibilla

Surface area (2011)

	Total surface area (km²)	MCT surface area (km²)	% MCT/total
Murcia	11,313.91	9,739.27	86.08%
Alicante	5,816.53	1,827.58	31.42%

Population (2011)

	Total population	MCT Population	% MCT/total
Murcia	1,470,069	1,409,330	95.87%
Alicante	1,934,127	1,102,934	57.02%

Social Security members

	Members	MCT Members	% MCT/total
Murcia	472,604	450,065	95.23%
Alicante	515,743	313,432	60.77%

Source: Mancomunidad de Canales del Taibilla, Social Security.

The regions supplied by the MCT include the main tourist destinations in Murcia and some of the most important tourist destinations in Alicante. Box 2 details a number of illustrative case studies of municipalities and the kinds of tourism activities that are undertaken in those areas.

Box 2 – Tourism municipalities supplied by the Mancomunidad de Canales del Taibilla: case studies

Inland municipalities

In these areas, tourism mainly focuses on culture (primarily the historical heritage of certain municipalities) and nature. Health tourism (for example, spas) is also very important in certain municipalities, such as Archena and Fortuna. Based on figures for 2012, tourism in the inland area of the Region of Murcia attracted almost 150,000 visitors, of which 14% were foreign. Some of the key regions that attract tourists of this kind include:

- *The Ricote Valley*. Located in the North of the Region of Murcia and middle basin of the Segura River. The area comprises the municipalities of Archena, Blanca, Ojós, Cieza, Ulea, Ricote, Abarán and Villanueva del Río Segura. In 2012, this region was characterised by a type of rural tourism that received more than 68,000 visitors, who registered almost 240,000 over night stays. 11.9% of those visitors were from overseas.
- *Lorca and Puerto Lumbreras*. These municipalities, located in the West of the Region of Murcia, received almost 48,000 visitors in total in 2012, of which 15% came from overseas. The tourist interest in these areas stems from the natural landscapes (the inland mountain ranges, the Guadalentín Valley, etc.) and its historical legacy (the Argar cultural sites in Lorca).

Coastal municipalities

The tourist appeal of these municipalities is mainly due to the beaches and the climate. Some of the main coastal municipalities supplied by the Mancomunidad de Canales del Taibilla include:

- *Santa Pola*, located in the South of Alicante, close to Elche. With more than 11 kilometres of beaches, Santa Pola attracts thousands of tourists every year. The percentage of foreign visitors exceeds 40%.
- *Torrevieja*, located in the South of Guardamar del Segura. More than 14 kilometres of beaches and with the added attractions of the Lagunas de La Mata and the Torrevieja Natural Park.
- *La Manga del Mar Menor* is one of Murcia's primary tourist attractions. It belongs to the municipalities of Cartagena and San Javier and is home to 30 beaches. It received more than 118,000 visitors in 2012, of which 16% were non-resident in Spain.
- *Mazarrón*, located to the West of Cartagena. 32 beaches spread over 35 kilometres. It has 4,500 beds (including hotels, campsites, etc.) and received more than 38,000 visitors in 2012. This municipality attracts one fifth of all the foreign tourists that visit Murcia.

Sports tourism

Centred primarily around the 20 golf courses[60] in the province, but also offering the possibility to dive, snorkel and participate in other water sports. Some of the municipalities that specialise in this kind of tourism include:

- *Fuente-Álamo*, located 35 kilometres from the capital of Murcia, in a natural setting, with an 18-hotel golf course.
- *Torre Pacheco*, located 15 kilometres from Cartagena. This municipality has two golf courses, one 9-hole course that is operated by the municipality and another 18-hole course.

Urban tourism

Tourism that focuses on the most important cities in the region, specifically on their cultural heritage and capacity to host conferences and events. This kind of tourism resulted in 467,000 visitors and more than 784,000 overnight stays in 2012 in the cities in the Region of Murcia (Cartagena, Lorca and Murcia).

Murcia. Business and conference tourist plays a major role in this city, which received more than 323,000 visitors in 2012, of which 15% were non-resident in Spain.

Cartagena. Received 96,000 visitors in 2012, of which 18.2% were from overseas. Traditionally focused on sun and beach tourism, recently, the city has marketed itself as a destination for cultural, cruise ship and conference tourism. Cartagena has between 900 and 4,000 hotel beds, depending on the radius considered around the capital.

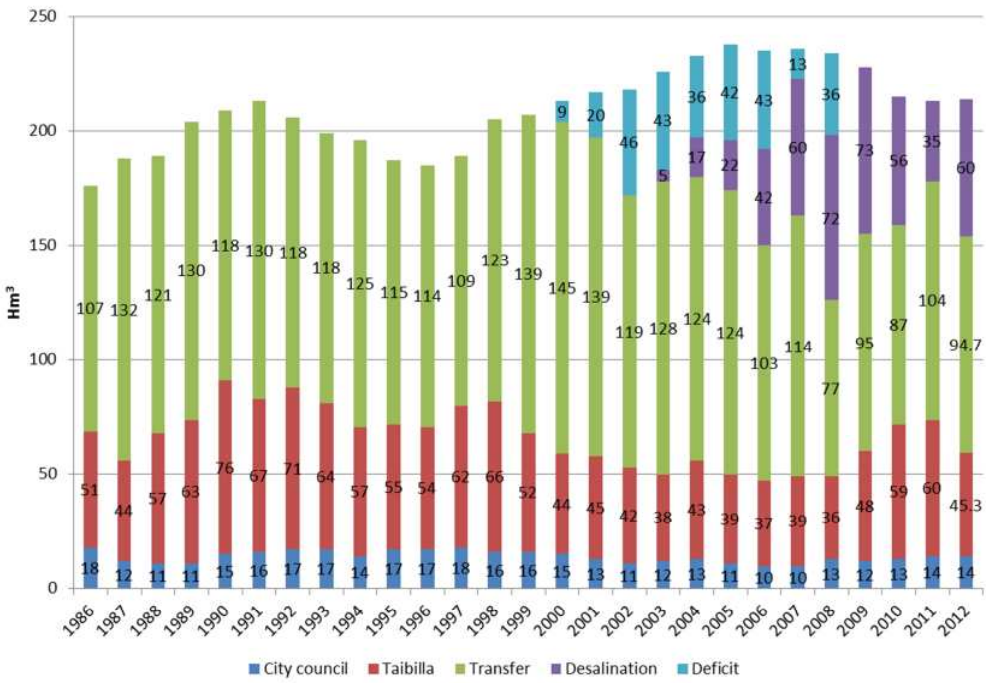
Alicante. During 2011, the city of Alicante received more than 600,000 visitors, almost 45% of whom were foreigners. It has a supply of more than 6,700 hotel beds (and this figure increases to 10,000 if we consider other accommodation options as well). Like Cartagena, the city has traditionally focused on holiday tourism, but is now emerging as a venue for conference tourism.

Source: Websites of the town halls and tourism bodies in the region.

[60] According to the information available, golf courses are not irrigated using water from the aqueduct, but rather using other available water resources, given that the aqueduct does not establish any provision for such use, but only for (agricultural) irrigation and human consumption.

Figure 10 shows the resources distributed by the MCT, broken down according to their origin. The figure shows that the aqueduct is the association's most abundant water source and accounted for 56% of its total supply on average, during the period 1986-2012, with peaks of 70% in certain years, such as in 1987. It is worth noting the ever-declining volume of water that is being sourced from the Rio Taibilla, which first led to the creation of the MCT, and which has gradually decreased in terms of importance in the face of contributions from the aqueduct and from desalination.

Figure 10. Resources distributed by the Mancomunidad de Canales del Taibilla, 1986-2012



Source: Mancomunidad de Canales del Taibilla and figures compiled by the author.

Despite the significant contribution made by the water supplied by the aqueduct, in recent years, water deficits have arisen, which have required contracts for the assignment of water rights with farmers in the Cuenca del Tajo and the territory of the Segura River Basin. The fundamental aim has been to avoid restrictions over the supply to member municipalities, which has occurred on several occasions. In this way, for example, in August 2003, the MCT's water resources were not sufficient to meet demand, which meant that 12-hour restrictions had to be introduced in 21 municipalities, affecting more than 200,000 users in the North-West of Murcia, Campo de Lorca and Cartagena.

4.3. Conclusion

The data presented in this section shows that tourism is a key determinant factor of wealth and employment in the region of Alicante and Murcia and that the water supplied by the aqueduct contributes to ensuring the supply to tourist municipalities in the region. In this way, the aqueduct may contribute to the development and maintenance of an industry that employs more than 320,000 people in the Region of Murcia and Community of Valencia as a whole.

Conclusions

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5. Conclusions

The main findings of our study are as follows:

- The main use of water supplied by the Tajo-Segura aqueduct is irrigation for agriculture. Agriculture is a strategic sector for Spain: its relative contribution to GDP is greater than in neighbouring countries and the EU average; Spain has a competitive advantage thanks to its privileged climatic conditions, which are hard to replicate; agriculture is a sector with export potential that contributes to our country's balance of trade surplus; it is also a sector that has fostered the development of the agri-food sector and of auxiliary goods and services; and it has contributed to the generation of employment and to keeping people in rural areas.

- In many cases, the region affected by the aqueduct has a greater relative economic dependence on agriculture. At the same time, this region contributes to a greater extent to a sector that is strategic for our country, contributing around 60% of the positive balance of the trade surplus of fruit and vegetable products, and producing high value added crops in relation to the volume of water consumed.

- The implementation of the aqueduct has been accompanied by the development of a modern and high-tech agricultural sector, which ranks amongst the best in Europe in terms of technological development. According to our estimates, this sector contributes €1,286 million to regional and national GDP and generates 73,160 jobs. If we also add the marketing and processing activities linked to the agricultural sector, then the agri-food industry that depends on water supplied by the Tajo-Segura aqueduct as a whole contributes €2,364 million to GDP and supports more than 100,000 jobs.

- We have performed analysis of historical series in order to determine the impact of a potential reduction in the volume of transported water, in the context of increasing scarcity of the resource in the future. Such a reduction may arise due to restrictions over the volume of water available at source, or due an increase in prices. Our estimates show that a 10% variation in the volume of water transported would result in a 4.3% variation in the volume of agricultural production over the medium-long term. The economic impacts on the agricultural sector and on marketing activity would be at least proportional. The impact on processing activities would depend on the possibilities for obtaining alternative supply sources.

- Similarly, water supplied by the aqueduct is used for domestic and industrial supply in municipalities that are, in many cases, important tourist destinations. By contributing to guaranteeing the supply, and minimising the risk of restrictions and cuts in the supply in the case of scarcity, water from the aqueduct may have therefore also supported the development of another key industry in the region affected by the aqueduct, namely, tourism. The available data shows that the tourism sector supports more than 320,000 jobs in the Autonomous Communities where the aqueduct has the greatest impact, i.e. in the Community of Valencia and the Region of Murcia.

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Annexes

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Annex A – Land irrigated using water from the aqueduct

Table 25. Distribution of the land irrigated using water from the aqueduct, by geographic region

	ha
Vegas Alta y Media del Segura	**21,632**
Area 1 (Cieza, Calasparra)	4,479
Area 2 (Abarán, Blanca, Ullea)	3,673
Area 3 (Archena, Molina)	2,802
Area 4 (Albanilla, Fortuna, Santomera)	6,313
Area 5 (Cotillas, Albudeite, Ojós, Alguazas, Ceutí, Villanueva)	4,365
River Mula Region	**3,150**
Lorca and Guadalentín Valley	**27,815**
Lorca	12,190
Guadalentín Valley	15,625
Levante and Vega Baja del Segura	**58,878**
Irrigation in Levante, left bank	38,190
Irrigation in Levante, right bank	3,993
La Pedrera	15,195
Albatera salt marshes	1,500
Campos de Cartagena	**32,800**
Almanzora Valley	**3,000**
TOTAL	**147,276**

Source: SCRATS.

Annex B – Municipalities supplied by water from the aqueduct

Table 26. Municipalities in the areas irrigated by water from the Tajo-Segura aqueduct

Alicante	Murcia	Almería
Albatera	Abanilla	Antas
Algorfa	Abarán	Cuevas de Almanzora
Alicante	Albudeite	Huercal-Overa
Almoradí	Alguazas	Vera
Benejúcar	Alhama de Murcia	
Benferri	Archena	
Benijófar	Blanca	
Bigastro	Calasparra	
Callosa del Segura	Blancos del Río	
Campello	Cartagena	
Catral	Ceutí	
Cox	Cieza	
Crevillente	Fortuna	
Elche	Fuente Álamo	
Granja de Rocamora	Las Torres de Cotillas	
Guardamar del Segura	Librilla	
Jacarilla	Lorca	
Muchamiel	Lorquí	
Orihuela	Los Alcázares	
Pilar de la Horadada	Mula	
Redován	Murcia	
Rojales	Ojós	
San Juan de Alicante	Ricote	
San Miguel de Salinas	San Javier	
Santa Pola	San Pedro del Pinatar	
Torrevieja	Sangonera	
	Santomera	
	Torre Pacheco	
	Totana	
	Ulea	
	Villanueva del Río Segura	

Source: SCRATS, Report about the impact of the 2004/05 drought on irrigation using water from the Tajo-Segura aqueduct.

Table 27. Municipalities supplied by the Mancomunidad Canales del Taibilla

Alicante	Murcia	Albacete
Albatera	Abanilla	Férez
Algorfa	Abarán	Socovos
Alicante	Aguilas	
Almoradí	Albudeite	
Aspe	Alcantarilla	
Benejúzar	Aledo	
Benferri	Alguazas	
Benijófar	Alhama de Murcia	
Bigastro	Archena	
Callosa del Segura	Beniel	
Catral	Blanca	
Cox	Bullas	
Crevillente	Calasparra	
Daya Nueva	Campos del Río	
Daya Vieja	Caravaca de la Cruz	
Dolores	Cartagena	
Elche	Cehegín	
Formentera del Segura	Ceutí	
Granja de Rocamora	Cieza	
Guardamar del Segura	Fortuna	
Hondón de las Nieves	Fuente Álamo	
Jacarilla	La Unión	
Los Montesinos	Las Torres de Cotillas	
Orihuela	Librilla	
Pilar de la Horadada	Lorca	
Rafal	Lorquí	
Redován	Los Alcázares	
Rojales	Mazarrón	
San Fulgencio	Molina de Segura	
San Isidro	Moratalla	
San Miguel de Salinas	Mula	
San Vicente del Raspeig	Murcia	
Santa Pola	Ojós	

Source: SCRATS, Report about the impact of the 2004/05 drought on irrigation using water from the Tajo-Segura aqueduct.

Table 28. Municipalities supplied by the Mancomunidad Canales del Taibilla (cont.)

Alicante	Murcia	Albacete
Torrevieja	Pliego	
	Puerto Lumbreras	
	Ricote	
	San Javier	
	San Pedro del Pinatar	
	Santomera	
	Torre Pacheco	
	Totana	
	Ulea	
	Villanueva del Río Segura	

Source: SCRATS, Report about the impact of the 2004/05 drought on irrigation using water from the Tajo-Segura aqueduct.

Annex C – Key assumptions used to calculate the value of agricultural production

Table 29. Land irrigated using water from the aqueduct, by crop type and geographic region

Irrigation area	Citrus fruits	Orchard fruits	Vegetables	Greenhouses	Almond tree	Olive tree	Vine arbour	Other woody fruit trees	Fallow land	TOTAL
Vegas alta y media del segura	7,022	11,041	1,279	0	300	371	1,459	54	107	21,632
Area 1 (Cieza, Calasparra)	0	4,031	448	0	0	0	0	0	0	4,479
Area 2 (Abarán, Blanca, Ullea)	434	2,377	0	0	59	0	804	0	0	3,673
Area 3 (Archenea, Molina)	841	1,401	140	0	0	0	420	0	0	2,802
Area 4 (Albanilla, Fortuna, Santomera)	4,247	367	691	0	242	371	235	54	107	6,313
Area 5 (Cotillas, Albudeite, Ojós, Alguazas, Ceutí, Villanueva	1,501	2,864	0	0	0	0	0	0	0	4,365
River Mula Region	1,112	1,835	203	0	0	0	0	0	0	3,150
Lorca and the Guadalentín Valley	6,051	2,522	13,513	0	502	376	1,770	1,863	1,219	27,815
Lorca	0	1,707	9,264	0	0	0	0	0	1,219	12,190
Guadalentín Valley	6,051	815	4,248	0	502	376	1,770	1,863	0	15,625
Irrigation in Levante, left and right banks. Vegas bajas del segura and Alicante salt marshes	37,245	37	6,990	110	9,698	0	803	3,714	281	58,878
Irrigation in Levante, left bank	18,896	37	5,192	0	9,698	0	653	3,714	0	38,190
Irrigation in Levante, right bank	3,554	0	439	0	0	0	0	0	0	3,993
La Pedrera	13,595	0	1,209	110	0	0	0	0	281	15,195
Albatera salt marshes	1,200	0	150	0	0	0	150	0	0	1,500
Campo de Cartagena	8,856	1,312	16,118	2,250	0	0	0	0	4,264	32,800
Almanzora Valley in Almería	1,030	0	1,010	550	0	330	0	80	0	3,000
TOTAL	**61,316**	**16,747**	**39,113**	**2,910**	**10,500**	**1,077**	**4,032**	**5,710**	**5,871**	**147,276**

Source: SCRATS.

Table 30. Production per hectare in the region affected by the aqueduct (mt/ha)

Crop	Alicante	Murcia	Almería
Vegetables	32.33	32.24	60.14
Citrus fruits	17.89	15.28	24.87
Orchard fruits	8.36	12.86	5.62
Almond trees	0.64	0.43	0.22
Olive trees	1.40	1.39	2.44
Vine arbours	6.63	5.30	6.24

Source: SCRATS, Autonomous Community for the Region of Murcia (Regional Agricultural Statistics), figures compiled by the author.

Table 31. Average prices (2007-2011) in source market (€/kg, 2012)

Product	Average price
Vegetables:	**0.51**
Artichoke	0.76
Asparagus	1.59
Aubergine	**0.55**
Broad bean	0.90
Broccoli	**0.42**
Cabbage	0.28
Carrot	**0.32**
Cauliflower	0.45
Celery	**0.27**
Chard	0.32
Cucumber	**0.83**
Curly endive	0.38
Garlic	**1.71**
Green bean	1.41
Green pea	**2.37**
Leek	0.55
Lettuce	**0.42**
Melon	0.40
Onion	**0.29**
Pepper	0.69
Potato	**0.48**
Pumpkin and courgette	0.39
Spinach	**0.70**
Strawberry	1.31
Tomato	**0.49**
Watermelon	0.29

Product	Average price
Citrus fruits	**0.37**
Grapefruit and other citrus fruit	0.26
Lemon	0.39
Mandarin	0.43
Orange	0.34
Orchard fruits	**0.85**
Apple	0.34
Apricot	0.85
Cherry	1.47
Fig	1.34
Hazelnut	1.66
Loquat	0.99
Peach	0.93
Pear	0.81
Persimmon	0.45
Plum	0.53
Pomegranate	0.73
Almond	**3.83**
Olive	**0.53**
Vine	**0.78**

Source: MAGRAMA, Autonomous Community for the Region of Murcia, figures compiled by the author.

Annex D – Breakdown of agricultural and marketing costs

Table 32. Breakdown of production costs by crop type

Concept	Vegetables	Citrus fruits	Orchard fruits	Almonds	Olives	Vines
Seeds and plants	20.3%	0.0%	0.0%	0.0%	0.0%	2.7%
Fertilisers	17.5%	15.6%	10.1%	42.3%	25.8%	8.8%
Pesticides	9.0%	11.7%	14.2%	10.4%	14.4%	12.2%
Other supplies	29.7%	53.7%	37.4%	6.3%	3.8%	14.3%
Water for irrigation	23.3%	44.8%	31.3%	5.3%	0.0%	0.0%
Crop insurance	3.8%	4.4%	3.1%	0.5%	3.8%	14.3%
Materials	2.6%	0.0%	3.1%	0.5%	0.0%	0.0%
Transport	0.0%	4.4%	0.0%	0.0%	0.0%	0.0%
Machinery costs	3.1%	1.9%	4.3%	9.9%	22.7%	24.1%
Contracted work	0.6%	0.2%	1.2%	5.9%	5.0%	14.6%
Fuel/lubricants	2.2%	1.2%	2.0%	3.9%	12.3%	4.7%
Repairs/spare parts	0.3%	0.5%	1.0%	0.0%	5.3%	4.8%
Social charges	5.9%	6.7%	5.4%	9.0%	9.4%	12.1%
Insurance own funds	0.5%	0.7%	0.5%	3.4%	1.1%	1.2%
Interest/Financial costs	0.0%	0.0%	0.0%	5.8%	0.0%	1.4%
Property rental fee	0.7%	0.0%	4.9%	0.0%	0.0%	0.8%
Contributions/tax	0.4%	1.1%	1.4%	4.3%	2.3%	0.9%
Building maintenance	0.5%	0.7%	0.7%	0.0%	0.0%	1.9%
Other general expenses	0.1%	0.4%	2.4%	0.0%	2.3%	1.1%
Depreciation	12.2%	7.6%	18.7%	8.5%	18.2%	18.4%
Land	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Buildings	9.3%	3.8%	9.4%	4.3%	9.1%	7.2%
Machinery	2.9%	3.8%	9.4%	4.3%	9.1%	11.2%
TOTAL	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: MAGRAMA, figures compiled by the author.

Table 33. Breakdown of marketing costs by crop type

Concept	Vegetables	Citrus fruits	Orchard fruits
Transport	26.1%	26.8%	32.8%
General expenses	18.3%	15.0%	22.5%
Fixed	11.3%	9.2%	13.8%
Utilities	4.8%	4.0%	5.9%
Water	0.2%	0.1%	0.2%
Electricity	4.4%	3.6%	5.4%
Gas	0.3%	0.2%	0.4%
Association fees	0.3%	0.2%	0.3%
External services	6.2%	5.1%	7.6%
Depreciation	7.0%	5.8%	8.6%
Buildings/facilities	2.2%	1.8%	2.7%
Machinery and Equipment	4.3%	3.5%	5.3%
Vehicles	0.6%	0.5%	0.7%
Manufacturing	55.6%	58.2%	44.7%
Containers	48.8%	51.1%	39.3%
Packaging	5.6%	5.9%	4.5%
Labels	1.1%	1.2%	0.9%
TOTAL	**100.0%**	**100.0%**	**100.0%**

Source: MAGRAMA, figures compiled by the author.

Annex E – The Input-Output model

The Input-Output methodology is based on Leontief's production model, which states that the production requirements of an economy are equivalent to the intermediate demand for goods and services by the production sectors, plus final demand, as expressed in the following equation:

$$X = AX + y$$

where X is the column vector that represents the production needs of each sector in the economy (there are 73 in Spain's National Accounting register in total), y is a column vector that represents the final demand of each sector, and A is a matrix (73 rows x 73 columns), containing technical coefficients, which by row indicate the percentage of production destined to each one of the other sectors in the economy for each specific sector, and by column indicate the weight that demand by each one of the other sectors in the economy has over its total production of goods and services for each sector. The aforementioned formula can also be represented in the following way:

$$\begin{bmatrix} X_1 \\ X_2 \\ X_3 \\ \\ \\ X_{79} \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} & a_{13} & \dots & a_{179} \\ a_{21} & a_{22} & a_{23} & \dots & a_{279} \\ a_{31} & a_{32} & a_{33} & \dots & a_{379} \\ & & & & \\ & & & & \\ a_{791} & a_{792} & a_{793} & \dots & a_{7979} \end{bmatrix} \times \begin{bmatrix} X_1 \\ X_2 \\ X_3 \\ \\ \\ X_{79} \end{bmatrix} + \begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ \\ \\ y_{79} \end{bmatrix}$$

where, e.g., X1 are the production needs of sector 1, y1 is the final demand for that sector and a11, a12, a13, ..., a173 are the percentages of production of sector 1 used for sectors 1, 2, 3, ..., 73, respectively, whilst a11, a21, a31, ..., a731 are the weights of sectors 1, 2, 3, ..., 73, respectively, over the production by sector 1 of the goods and services demanded.

If we rearrange the formula above, we can calculate the production needs of an economy (X) based on final demand (y). This takes the following structure:

$$X = (I-A)\text{-}1\ y$$

Where (I-A)-1 is the inverse Leontief matrix or the production multiplier matrix, which is used to calculate the impacts.

The production multiplier matrix that we have used in our analysis has been calculated using data published by INE. This matrix has allowed us to calculate, for each euro spent or invested in the various sectors recorded in Spain's National Accounting register (that is, for each euro of final demand), the impact in terms of gross production (i.e. in terms of the production needs).

Using the production multiplier matrix, we have proceeded to calculate the employment multipliers. To that end, using data from INE, we have firstly calculated the direct employment coefficients for each sector (the ratio between the number of employees and production). Subsequently, we have calculated the employment multipliers by multiplying the production multiplier matrix by a column vector containing the direct employment coefficients calculated for each sector. Table 34 shows the value of the production and employment multipliers that have been obtained using the methodology described above.

The induced production multipliers have been calculated on the basis of the weight of household incomes (compensation received by employees) over the production of each one of the affected sectors and their marginal propensity to consume (we have adopted a conservative value of 0.4 taking into account the findings reported in the wider literature).

Table 34. Multipliers for the sectors in Spain's National Accounting register

Sector	Production	Employment(*)
Agriculture, livestock and hunting	1.77	0.029
Forestry	1.12	0.017
Fisheries and aquaculture	1.58	0.027
Mining of coal and lignite; extraction of peat	1.81	0.016
Extraction of petroleum and natural gas. Extraction of uranium and thorium	2.30	0.015
Extraction of metallic minerals	2.14	0.014
Extraction of non-metallic minerals	1.87	0.012
Manufacture of coke oven products, refinement and nuclear fuels	1.28	0.002
Production and distribution of electricity	1.84	0.005
Production and distribution of gas	1.09	0.001
Collection, purification and distribution of water	1.91	0.015
Meat industry	2.46	0.023
Dairy industry	2.42	0.019
Other food industries	2.32	0.020
Beverage industry	2.31	0.015
Tobacco industry	1.70	0.010
Textile industry	1.84	0.018
Manufacture of made-up textile articles and fur articles	2.01	0.025
Manufacture of leather and leather products	2.03	0.022
Manufacture of wood and wood and cork products	1.85	0.019
Paper industry	1.78	0.011
Publishing and graphic arts	1.84	0.015
Chemical industry	1.58	0.008
Manufacture of rubber and plastic products	1.79	0.012
Manufacture of cement, lime and plaster	1.83	0.010
Manufacture of glass and glass products	1.87	0.015
Ceramics industry	1.89	0.016
Manufacture of other non-metallic mineral products	2.14	0.014
Metallurgy	2.15	0.012
Manufacture of fabricated metal products	1.88	0.015
Manufacture of machinery and equipment	1.84	0.015
Manufacture of office machinery and computers	1.59	0.013

Sector	Production	Employment(*)
Manufacture of machinery and electrical materials	1.89	0.011
Manufacture of electronic material	1.55	0.011
Medical, precision and optical instruments	1.61	0.015
Manufacture of motor vehicles, trailers and semi-trailers	1.75	0.009
Manufacture of other transport equipment	1.79	0.012
Furniture and other manufacturing industries	1.88	0.022
Recycling	2.64	0.014
Construction	2.35	0.020
Sale, maintenance and repair of motor vehicles; retail sale of automotive fuel	1.93	0.019
Wholesale trade and intermediaries	1.61	0.016
Retail trade, repair of personal and household goods	1.55	0.033
Accommodation	1.62	0.020
Catering industry	1.78	0.018
Rail transport	1.81	0.014
Land transport and transport via pipelines	1.83	0.019
Maritime transport	1.67	0.009
Air and space transport	1.59	0.008
Activities relating to transport	2.00	0.015
Activities of travel agencies	1.76	0.013
Post and telecommunications	1.78	0.011
Financial intermediation	1.30	0.009
Insurance and pension plans	1.83	0.011
Ancillary activities	1.68	0.012
Real estate	1.45	0.006
Renting of machinery and equipment without operator and of personal and household goods	1.73	0.013
Computing activities	1.51	0.013
Research and development	1.55	0.017
Other business activities	1.66	0.020
Education (market)	1.34	0.022
Health care and social services (market)	1.48	0.021
Public sanitation (market)	1.72	0.016
Associative activities (market)	1.59	0.026
Recreational, cultural and sporting activities (market)	1.55	0.016
Other service activities	1.66	0.037
Public administration	1.42	0.023
Education (non-market)	1.14	0.023

Sector	Production	Employment(*)
Health care and social services (non-market)	1.40	0.020
Public sanitation (market)	2.39	0.015
Associative activities (non-market)	1.84	0.024
Recreational, cultural and sporting activities (non-market)	1.84	0.020
Households employing domestic personnel	1.00	0.067

NOTES: (*) Number of jobs per €1,000 of final production value in the sector.
Source: PwC Analysis using data from Spain's National Accounting register.

Annex F – Major processing companies

Table 35. Ranking of the top 50 processing companies in the provinces affected by the aqueduct, by turnover

Company		Province	Revenues (€'000)	Activity	Region affected by aqueduct
1	Amc Grupo Alimentación	Murcia	513,217	Manufacture of fruit and vegetable juices	YES
2	Hero España SA	Murcia	213,822	Other processing and preserving of fruits & vegetables	NO
3	Juver Alimentación SL	Murcia	150,844	Manufacture of fruit and vegetable juices	YES
4	Corporación Alimentaria FJ Sánchez SL	Almería	140,181	Other processing and preserving of fruits & vegetables	NO
5	La Española Alimentaria Alcoyana SA	Alicante	80,847	Other processing and preserving of fruits & vegetables	NO
6	Aceitunas Cazorla SL	Alicante	75,302	Other processing and preserving of fruits & vegetables	YES
7	Marín Montejano, SA	Murcia	64,496	Other processing and preserving of fruits & vegetables	YES
8	Ultracongelados Azarbe SA	Murcia	48,827	Other processing and preserving of fruits & vegetables	YES
9	Cofrutos SA	Murcia	42,831	Manufacture of fruit and vegetable juices	NO
10	Amgat Citrus Products SA	Murcia	33,889	Manufacture of fruit and vegetable juices	YES
11	Fruveco SA	Murcia	33,754	Other processing and preserving of fruits & vegetables	YES
12	Agrumexport, SA	Murcia	33,748	Manufacture of fruit and vegetable juices	YES
13	Alcurnia Alimentación SL	Murcia	31,589	Other processing and preserving of fruits & vegetables	NO
14	Golden Foods SA	Murcia	31,318	Other processing and preserving of fruits & vegetables	YES
15	Conservas y Frutas SA	Murcia	30,473	Other processing and preserving of fruits & vegetables	YES
16	SAT N 254 CV Quirante Fruits	Alicante	27,002	Manufacture of fruit and vegetable juices	YES
17	Colefruse Internacional SA	Alicante	25,423	Other processing and preserving of fruits & vegetables	NO
18	Cándido Miro SA	Alicante	24,738	Other processing and preserving of fruits & vegetables	NO
19	Agrotransformados Sociedad Anónima	Murcia	21,516	Manufacture of fruit and vegetable juices	YES
20	Frutas y Conservas de Murcia SL	Murcia	20,669	Manufacture of fruit and vegetable juices	YES

Company		Province	Revenues (€'000)	Activity	Region affected by aqueduct
21	Mensajero Alimentación SL	Murcia	20,432	Other processing and preserving of fruits & vegetables	NO
22	Lozano SA	Murcia	16,739	Other processing and preserving of fruits & vegetables	NO
23	Faroliva SL	Murcia	15,535	Other processing and preserving of fruits & vegetables	YES
24	Manuel Mateo Candel SL	Alicante	14,149	Other processing and preserving of fruits & vegetables	YES
25	Hida Alimentación SA	Murcia	14,029	Other processing and preserving of fruits & vegetables	YES
26	Tropicana Alvalle SL	Murcia	12,915	Manufacture of fruit and vegetable juices	YES
27	Conservas Alguazas SL	Murcia	12,683	Manufacture of fruit and vegetable juices	YES
28	Cítricos del Andarax, SA	Almería	12,163	Manufacture of fruit and vegetable juices	NO
29	Hortofrutícola 3 Puentes S.L.	Alicante	12,104	Other processing and preserving of fruits & vegetables	NO
30	Agrucapers SA	Murcia	11,920	Other processing and preserving of fruits & vegetables	NO
31	Congelados El Pedaneo SA	Murcia	10,272	Other processing and preserving of fruits & vegetables	YES
32	SAT Número 9157 Campounión	Murcia	9,815	Other processing and preserving of fruits & vegetables	YES
33	Nutrafur SA	Murcia	9,594	Manufacture of fruit and vegetable juices	NO
34	Riverbend España SA	Murcia	8,191	Manufacture of fruit and vegetable juices	YES
35	Conservas Martínez García SL	Murcia	7,907	Other processing and preserving of fruits & vegetables	YES
36	Citromil SL	Murcia	7,358	Manufacture of fruit and vegetable juices	YES
37	Derivados Cítricos SA	Murcia	7,244	Manufacture of fruit and vegetable juices	NO
38	Pedro Guillen Gomáriz SL	Murcia	6,839	Other processing and preserving of fruits & vegetables	YES
39	Murflor SL	Murcia	6,679	Other processing and preserving of fruits & vegetables	YES
40	Agrotul Green SL	Murcia	6,275	Other processing and preserving of fruits & vegetables	YES
41	Verco Export SL.	Murcia	5,808	Other processing and preserving of fruits & vegetables	YES
42	Conservas Hola SL	Alicante	5,739	Other processing and preserving of fruits & vegetables	YES

Company		Province	Revenues (€'000)	Activity	Region affected by aqueduct
43	Baby Foods SA	Murcia	5,623	Manufacture of fruit and vegetable juices	YES
44	Congelados Españoles SA	Murcia	5,550	Other processing and preserving of fruits & vegetables	YES
45	Industrias Agrícolas del Almanzora SL	Almería	4,775	Other processing and preserving of fruits & vegetables	NO
46	Luxeapers Sociedad Limitada.	Almería	4,732	Other processing and preserving of fruits & vegetables	NO
47	Bernabé Biosca Alimentación SA	Alicante	4,575	Other processing and preserving of fruits & vegetables	YES
48	MM Iberia Fresh and Natural Food S.L.	Murcia	4,502	Manufacture of fruit and vegetable juices	YES
49	Albel Frío y Medioambiente SL	Alicante	4,443	Other processing and preserving of fruits & vegetables	YES
50	Manipulados Hortofrutícolas San Andrés SL	Alicante	4,099	Other processing and preserving of fruits & vegetables	YES

NOTE: The revenue figures correspond to the latest information available in SABI. We have excluded those companies whose most recent annual accounts in SABI correspond to periods prior to 2010, with the exception of Hero España SA. The revenues for that company in 2010 have been extracted from Alimarket.
Source: SABI, Alimarket and figures compiled by the author.

Annex G – Results of the econometric model

Interpretation of the model's parameters and calculation of elasticities

In section O of this report, we have presented a formula or model that explains the volume of agricultural production in the provinces of Alicante and Murcia, as a function of the volume of water supplied by the aqueduct. Within this model, β_1 is the elasticity or sensitivity of production with respect to the volume of transported water in the short term. β_2 measures the relationship that exists between production in a given period and the previous period.

Given the influence of production volumes in previous periods on production volumes in the current and future periods, elasticity over the long term is determined by the sequence of relationships between the volume produced and the consumption of transported water at different points in time. The first application of this idea leads us to the following formula:

$$Q_t = \beta_0 + \beta_1 \times TRASV_t + \beta_2 \times Q_{t-1} \qquad (1)$$
$$Q_{t+1} = \beta_0 + \beta_1 \times TRASV_{t+1} + \beta_2 \times Q_t \qquad (2)$$

Substituting (1) into (2), we obtain:

$$Q_{t+1} = \beta_0 + \beta_1 \times TRASV_{t+1} + \beta_2 \times (\beta_0 + \beta_1 \times TRASV_t + \beta_2 \times Q_{t-1})$$

We can see that the parameter β_1 appears multiplying β_2 as well. The repetition of this exercise for subsequent periods leads us to the following sequence:

$$\beta_1 + \beta_1 \times \beta_2 + \beta_1 \times (\beta_2)^2 + \beta_1 \times (\beta_2)^3 + \beta_1 \times (\beta_2)^4 + \ldots$$

The aforementioned sequence, which represents the elasticity or sensitivity of production to the volume of water supplied by the aqueduct over the long term, is equivalent to the following formula:

$$\varepsilon_{l/p} = \beta_1 / (1-\beta_2)$$

Results of the estimations

Table 36 shows the results of the econometric model. [61] All of the coefficients estimated are statistically significant to 5% (indicated by the fact that their p-values are less than or equal to 0.05). Meanwhile, the R2 of 0.8376 indicates that the model explains a very significant percentage (83.76%) of the variability in agricultural production volumes in the provinces of Alicante and Murcia.

The elasticity value in the short term (β_1) is 0.0509215. The coefficient associated with production in the previous period (β_2) is 0.7682224. The elasticity value over the long term, calculated using the formula derived above is 0.2196998.

[61] With these results, the proposed model would be as follows:

$$Q_t = 1.652685 + 0.0509215 \times TRASV_t + 0.7682224 \times Q_{t-1} + \varepsilon_t$$

Table 36. Results of the econometric model

Variable	Coefficient	p-value
Constant	1.652685	0.039
$TRASV_t$	0.0509215	0.050
Q_{t-1}	0.7682224	0.000
R2		**0.8376**

Source: MAGRAMA and figures compiled by the author.

The elasticity values above refer to the total production volumes in the provinces of Alicante and Murcia as a whole. To reflect the region affected by the aqueduct only, we must adjust them to reflect the fact that this region accounts for 51.4% of total production in the provinces that form the subject of our analysis. The resulting elasticities for the region affected by the aqueduct are those reported in section 0 of this report.