SCIENTIFIC INFORMATION

Competition among agriculture and other sectors for water and land use: A case study of agricultural activity in the southern regions of Spain

Zemědělství a ostatní sektory spolu soupeří o využití vody a půdy: případová studie zemědělské činnosti v jižních oblastech Španělska

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Abstract: The southern area of the province of *Alicante* (Spain) embraces the regions *Vega Baja del Segura* (The Low Valley of The Segura River) and *Bajo Vinalopó* (Low Vinalopó) in the Valencian Community. Although both regions have a growing residential, touristy and industrial potential, agriculture is still an important activity here. In this study, a characterization of agricultural land distribution in the southern regions of *Alicante* is carried out, regarding the main crops where the most important current problems are irrigation water shortage and low harvest prices. Incomes received by farmers according to the level of harvest prices and the evolution of these prices in the last two years are studied. Besides, prices have been noticed to keep stable at the best. The evolution of land for different uses, mainly industrial, is also estimated. The competition for land and water use with other sectors has significantly increased the amount of land for these uses and what is more, it is still on increase.

Key words: Mediterranean Europe, local scale, agricultural sector, hydrological resources

Abstrakt: Jižní oblast provincie Alicante (Španělsko) zahrnuje regiony Vaga baja del segura (dolní údolí řeky Segura) a Bajo Vinalopó (dolní Vinalopó) ve valencijském kraji. Ačkoliv obě oblasti mají rostoucí rezidenční, turistický a průmyslový potenciál, zemědělství je zde stále významnou činností. V této studii je charakterizována distribuce zemědělské půdy v jižních oblastech Alicante, pokud jde o hlavní zemědělské plodiny, u nichž je hlavním současným problémem nedostatek vody k zavlažování a nízké ceny sklizně. Analyzovány jsou rovněž příjmy farmářů ve vztahu k cenám sklizně a vývoj těchto cen v posledních dvou letech. Ceny byly v nejlepším případě na stabilní úrovni. Proveden byl rovněž odhad vývoje využití půdy pro různé účely, zejména průmyslové. Konkurence při využití vody a půdy mezi zemědělstvím a ostatními sektory výrazně zvýšila objem půdy pro tyto účely a to navíc stále roste.

Klíčová slova: Středozemní oblast Evropy, lokální rozměr, sektor zemědělství, hydrologické zdroje

The province of Alicante (Figure 1), located in the southern area of the Valencian Community, east of Spain, extends to the regions El Comptat, L' Alcoià, Alto Vinalopó, Medio Vinalopó, Marina Alta, Marina Baja, L'Alacantí, Bajo Vinalopó and Vega Baja del Segura. It has a surface area of 5 817.5 km^2, (Valencian Institute of Statistics 2005) a population of 1 657 040 inhabitants, an unemployment rate of 53 470 people dated on 31 March, 2004, and a total registered investment of 136 million € in 2004, 87.7 million

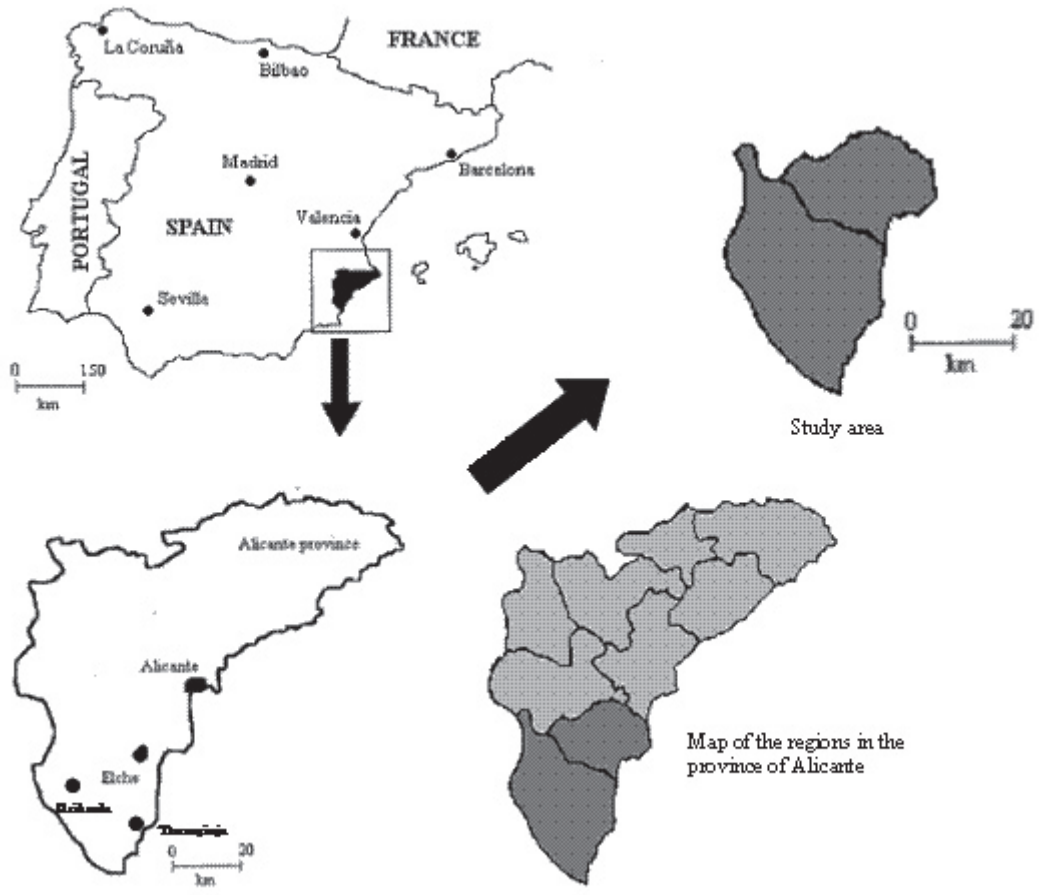

Figure 1. Location of the study area. Main towns and regions in the study area

on industrial investment and 48.3 million on non-industrial investment, according to the Valencian Institute of Statistics (2006).

The southern area of the province of *Alicante* embraces the regions *Vega Baja del Segura* and *Bajo Vinalopó*. The region *Vega Baja del Segura* is made up of 27 towns with a total area of 957.3 km^2, 16.5% of the total surface of the province, *Bajo Vinalopó* consists of 3 towns with an area of 489.2 km^2, 8.4% of provincial surface. *Vega Baja del Segura* has a population of 297 251 inhabitants and *Bajo Vinalopó* has 259 291, which is 17.9 and 15.7% respectively of the provincial total. The total figure for the whole Valencian Community is 4 543 304 inhabitants (Valencian Institute of Statistics 2006), so *Alicante* represents 36.5%.

In 2004, the taxable real estate area in *Vega Baja del Segura* was 95 694 ha and 48 980 ha in *Bajo Vinalopó*, with a provincial total of 575 057 ha and 2 277 424 ha in the whole Valencian Community. The number of landed properties was 61 462 in *Vega Baja* and 35 028 in *Bajo Vinalopó*, with 427 593 and 2 231 634 in *Alicante* and the Valencian Community respectively. Regarding urban units, *Vega Baja* had 298 655 and *Bajo Vinalopó* had 185 677, the province owned 1 360 357 and the total in the Community was of 3 606 801 (Ministry of Agriculture, Fishery and Food 2005). Although both regions have growing residential, touristy and industrial potential, agriculture is still an important activity here.

In 2005, the area dedicated to cultivation in *Vega Baja* was 53 629 ha and in *Bajo Vinalopó* was 18 636 ha, taking into account both, dry land and irrigated crops (Valencian Institute of Statistics 2006). This means 24.2% and 8.4% respectively of the total cultivated area (221 910 ha). These data imply that cultivated area decreased in the province as well as in both regions when comparing with the data of 2002, since that year the total cultivated area in the province was 261 289 ha, and 60 861 and 21 957 ha in the regions. The percentage was very similar in regions, 8.8% in *Vega Baja* and 8.5% in *Bajo Vinalopó*, the same as in the province of *Alicante* and lower than the total decrease of the Valencia Community, which was 9.4%.

In 2005, the irrigation area was 113 791 ha in the province of *Alicante*, a bit more than half the cultiva-

tion area (51.3% of the total), but in the regions of our study, this area was much more important reaching very high figures: 45 304 ha (84.5%) in *Vega Baja del Segura* and 17 512 ha in *Bajo Vinalopó* (94.0% of the total cultivated area) (Valencian Institute of Statistics 2006).

In this study, we carry out a characterization of agricultural land distribution in the southern regions of Alicante regarding the main crops, fruit, vegetables and citrus fruit where the most important current problems are irrigation water shortage and harvest low prices. Incomes received by farmers according to the level of harvest prices and the evolution of these prices in the last two years are studied. The evolution of land for different uses, mainly industrial, residential and recreational, is also estimated. Moreover, the data about the increasing relations of competition in water and land uses between the agricultural sector and other production sectors are considered.

Distribution of main crop groups

Table 1 shows the distribution of the main crops in the province of *Alicante* per region according to the Valencian Agricultural Sector Report (Generalitat Valenciana 2006). Fruit, citrus, olive groves and

Table 1. Distribution of the main crop groups per region in the province of Alicante (ha), year 2005

	El Comptat	L'Alcoià	Alto Vinalopó	Vinalopó Medio	Marina Alta	Marina Baja	L'Alacantí	**Bajo Vinalopó**	**Vega Baja**	**Total province**
Cereals	438	1 719	3 877	546	242	174	250	**1 776**	**1 934**	**10 956**
Roots	20	10	95	14	14	6	7	**170**	**373**	**709**
Vegetables	179	172	1 062	258	84	47	649	**1 756**	**6 590**	**10 797**
Other plant crops	110	706	572	298	29	151	131	**1 012**	**1 260**	**4 269**
Citric Fruit	0	0	0	11	6 948	2 134	392	**1 678**	**24 317**	**35 480**
Fruit	2 623	3 760	5 138	9 299	1 860	5 251	4 252	**3 284**	**5 495**	**40 971**
Vineyards	87	746	5 256	14 064	2 530	29	1 069	**527**	**694**	**25 002**
Olive groves	8 154	5 891	9 087	2 962	2 053	2 351	1 579	**563**	**331**	**32 971**
Other woody crops	3	0	0	0	1 019	298	342	**16**	**203**	**1 881**
Total	**11 614**	**13 004**	**25 087**	**27 452**	**14 779**	**10 441**	**8 671**	**10 782**	**41 197**	**163 036**

Source: Generalitat Valenciana 2006; Valencian Agricultural Sector Report 2005

Table 2. Distribution of citric crops per region of the province of Alicante (ha), year 2005

	El Comptat	L'Alcoià	Alto Vinalopó	Vinalopó Medio	Marina Alta	Marina Baja	L'Alacantí	**Bajo Vinalopó**	**Vega Baja**	**Total province**
Orange trees	0	0	0	7	3 043	1 258	210	**875**	**9 770**	**15 163**
Mandarin trees	0	0	0	1	3 780	268	89	**204**	**2 453**	**6 795**
Lemon trees	0	0	0	3	31	602	91	**591**	**11 972**	**13 290**
Others	0	0	0	0	94	6	2	**8**	**122**	**232**
Total	0	0	0	11	6 948	2 134	392	**1 678**	**24 317**	**35 480**
% s/total region	0	0	0	0	47.0	20.4	4.5	**15.6**	**59.0**	**21.7**
% s/total province	**0**	**0**	**0**	**0**	**19.6**	**6.0**	**1.1**	**4.7**	**68.5**	**100**

Source: Generalitat Valenciana 2006; Valencian Agricultural Sector Report 2005

vineyards are the most important groups, and they represent 25, 22, 20 and 15% respectively. The vegetables and cereals area is smaller, being in both cases of 7%.

The main crops in the regions of southern *Alicante* are, in particular, in *Vega Baja* citruses with more than half of the cultivated area (24 317 ha), vegetables which are 16%, (6 590 ha) and fruit (5 495 ha), 13%; in the region of *Bajo Vinalopó* fruit takes approximately a third of the cultivated area (3 284 ha), whereas citric fruit and vegetables take one sixth (1 678 and 1 756 ha respectively), the same as cereals (1 776 ha).

If these crops are analysed in detail, citrus (Table 2), are especially grown in *Marina Alta*, and *Vega Baja* where there are two thirds of the total in the province. If the distribution per type of crop is taken into account, in southern regions like in *Vega Baja* the main crop are lemon groves, approximately half the citrus groves area, whereas in *Bajo Vinalopó* they are orange groves and lemons take 35% of the total.

Regarding crops (Table 3), the main one is the almond tree which takes three quarters of the provincial area, the same figure as in the region of *Vega Baja*. Pomegranate tree cultivation is 5% of the provincial total, being higher in *Vega Baja*, and above all in *Bajo Vinalopó* where it is the most significant crop, 41% of the total of cultivated fruit. Under the heading "others", we include date plum trees, fig trees, quince trees and date palm trees, which are grown in both regions.

Vegetable crops (Table 4) are important in the analysed regions, being in both 16% of the total cultivated area in each region. In *Vega Baja* it is 61% when compared with the total in the province, which means that 61% of the total vegetables grown in *Alicante* are found in *Vega Baja*.

The artichoke is the main crop with 24% in *Vega Baja*, 17% in *Alicante* and 12% in *Bajo Vinalopó*. In the latter, the chief crop is endives and also melons, which take one quarter and one sixth respectively. Other relevant crops are lettuces (9% in *Vega Baja*, 5% in *Bajo Vinalopó*) and broad green beans (6% in *Bajo Vinalopó*, 3% in *Vega Baja*). Under the heading "others", it includes broccoli, celery, pepper, radish, carrot, parsnip and chards.

FARM PRICES INDEX IN THE PROVINCE OF ALICANTE

Prices received by farmers in the Valencian Community per province are shown in Table 5. The average rise was 7% in 2005 compared to 2004 in the province of *Alicante*. Apricots and peaches more than

Table 3. Distribution of fruit crops per region of the province of Alicante (ha), year 2005

	El Comptat	L'Alcoià	Alto Vinalopó	Vinalopó Medio	Marina Alta	Marina Baja	L'Alacantí	**Bajo Vinalopó**	**Vega Baja**	**Total province**
Apple trees	92	162	280	34	67	29	110	**4**	**6**	**784**
Pear trees	66	60	167	203	1	13	15	**17**	**6**	**548**
Medlar trees	0	0	0	12	0	1.266	6	**10**	**5**	**1 299**
Apricot trees	52	17	24	27	0	3	2	**7**	**5**	**137**
Cherry tree and mazzard cherry trees	728	80	268	15	604	28	15	**0**	**0**	**1 738**
Peach trees	262	60	87	116	11	3	70	**8**	**14**	**631**
Prune trees	122	220	283	38	10	7	28	**9**	**18**	**735**
Pomegranate trees	0	0	0	0	0	0	29	**1 334**	**677**	**2 040**
Almond trees	1 271	3 150	4 020	8 834	1 165	3 850	3 971	**1 105**	**4 223**	**31 589**
Others	39	11	9	20	1 009	348	347	**805**	**740**	**3 328**
Total	2 623	3 760	5 138	9 299	1 860	5 251	4 252	**3 284**	**5 495**	**40 971**
% s/total region	22.6	28.9	20.5	33.9	12.6	50.3	49.0	**30.5**	**13.3**	**25.1**
% s/total province	**6.4**	**9.2**	**12.5**	**22.7**	**4.5**	**12.8**	**10.4**	**8.0**	**13.4**	**100**

Source: Generalitat Valenciana 2006; Valencian Agricultural Sector Report 2005

Table 4. Distribution of vegetable crops per region in the province of Alicante (ha), year 2005

	El Comptat	L'Alcoià	Alto Vinalopó	Vinalopó Medio	Marina Alta	Marina Baja	L'Alacantí	**Bajo Vinalopó**	**Vega Baja**	**Total province**
Artichoke	4	1	3	33	5	3	16	**212**	**1 573**	**1 850**
Aubergine	3	0	3	2	5	0	1	**8**	**26**	**48**
Onion	16	7	43	6	8	5	2	**37**	**112**	**236**
Lettuce	4	2	2	63	2	3	93	**93**	**602**	**864**
Sprout and cabbage	3	2	9	3	2	1	3	**13**	**86**	**122**
Cauliflower	6	1	7	0	0	0	6	**25**	**229**	**274**
Endive	3	1	2	41	1	0	13	**429**	**165**	**655**
Spinach	12	3	35	4	1	0	2	**12**	**31**	**100**
Early and late strawberry	0	0	0	0	2	0	0	**0**	**0**	**2**
Broad green bean	12	4	5	17	7	6	34	**145**	**194**	**424**
French bean	5	3	2	3	1	4	6	**9**	**20**	**53**
Melon	6	5	8	12	7	3	1	**263**	**429**	**734**
Cucumber	7	2	3	2	2	0	1	**22**	**48**	**87**
Water melon	7	1	4	5	14	3	1	**0**	**114**	**149**
Tomato	13	8	10	27	13	8	442	**52**	**49**	**622**
Others	78	132	926	40	14	11	28	**436**	**2 912**	**4 577**
Total	179	172	1 062	258	84	47	649	**1 756**	**6 590**	**10 797**
% s/total region	1.5	1.3	4.2	0.9	0.6	0.5	7.5	**16.3**	**16.0**	**6.6**
% s/total province	**1.7**	**1.6**	**9.8**	**2.4**	**0.8**	**0.4**	**6.0**	**16.3**	**61.0**	**100**

Source: Generalitat Valenciana 2006; Valencian Agricultural Sector Report 2005

doubled their price in *Alicante*, whereas in the total of the Valencian Community their prices increased 25% and 50% respectively. Other crops whose price increased were almonds and onions, with 70% rise in both cases.

However, melon and water melon prices decreased almost to half in *Alicante* and a bit less in the Valencian Community. Cherries reduced its price 30% in *Alicante* and nearly to half in the whole Valencian Community.

When comparing the price evolution in 2004 and 2005, and between *Alicante* and the average in the Valencian Community, it is noticed that the crops with a higher price rise in the province of *Alicante* with respect to the Valencian Community were citrus: oranges and mandarins, and fruit-trees apricots, peaches and cherries. Some others were stable, that is, the price rise was homogeneous in the province and in the Valencian Community, such as the pomegranate, lemon, medlar, artichoke, onion and cauliflower. On the contrary, others decreased their prices in the province more than in the Valencian Community because of the influence on the figures in *Valencia* and *Castellón* by seed-fruit, apple and pear trees, stone-fruit, plum trees (where we find the biggest difference), and vegetables: especially melon and also lettuce and French bean.

In 2005, the prices perceived by farmers and stock-breeders general index (FPPI – Farmers Product Price Index) of the Valencian Community, estimated based on the 2000 production, were 0.4% higher than in the previous year in nominal terms (the national rise was by 0.9% for the same period). Since the annual rate of the CPI (Consumer Price Index) was 3.2% in 2005, the real decrease of the FPPI was 2.8% in the Valencian Community (2.3% national level). In the EU-25, the prices perceived by farmers were reduced by 8.6% in real terms (Generalitat Valenciana 2006).

Table 5. Farmers prices (€/kg) in the Valencian Community per province

	Alicante		Castellón		Valencia		Valencian community		2005/2004 × 100
	2004	2005	2004	2005	2004	2005	2004	2005	
Citric fruit									
Oranges	0.223	0.231	0.204	0.217	0.222	0.226	0.221	0.226	102.3
Mandarins	0.270	0.258	0.288	0.255	0.284	0.259	0.284	0.259	91.2
Lemons	0.233	0.197	0.159	0.185	0.206	0.195	0.233	0.197	84.5
Fruit trees									
Apples	0.499	0.455	0.479	0.585	0.490	0.290	0.493	0.484	98.2
Pears	0.556	0.558	0.569	0.700	0.569	0.704	0.565	0.657	116.2
Loquats	1.280	0.981	1.240	0.936	1.240	0.880	1.278	0.978	76.5
Apricots	0.916	2.392	1.375	1.350	1.145	1.395	1.139	1.426	125.3
Cherries	3.473	2.467	1.770	1.096	2.305	1.188	2.667	1.432	53.7
Peaches	0.609	1.286	0.623	0.948	0.666	0.949	0.662	0.996	150.5
Plums	0.458	0.314	0.386	0.419	0.688	0.710	0.678	0.677	99.8
Pomegranates	0.377	0.583	0.700	0.565	0.471	0.554	0.378	0.583	99.8
Almonds	0.944	1.602	0.977	1.690	1.013	1.513	0.982	1.597	162.6
Vegetables									
Artichokes	0.705	0.629	0.755	0.676	0.402	0.372	0.547	0.496	96.7
Onions	0.143	0.240	0.105	0.438	0.107	0.153	0.110	0.189	171.8
Lettuces	0.275	0.170	0.318	0.270	0.294	0.238	0.304	0.210	69.1
Cauliflowers	0.336	0.280	0.351	0.285	0.283	0.261	0.326	0.277	84.9
French beans	1.541	0.933	1.549	1.088	1.634	1.127	1.560	1.084	69.5
Melons	0.255	0.124	0.240	0.289	0.287	0.163	0.274	0.186	67.9
Water melons	0.236	0.139	0.215	0.066	0.194	0.091	0.197	0.091	46.2
Tomatoes	0.694	0.667	0.994	0.540	1.199	0.878	0.758	0.649	85.6

Source: Generalitat Valenciana 2006 and our own research

In Spain, the FPPI has been stable with a slight downward trend of 0.4%, vegetables decreased by a higher percentage, 6.9%, cereals by 0.3%, citric fruit by 3.9% and fresh non-citric fruit decreased by 3.0%. Dried fruit, olive oil and roots experienced price rise (Generalitat Valenciana 2006).

ORIGIN OF WATER RESOURCES IN THE ANALYSED AREAS

In *Alicante*, the average annual rainfall from 1971 to 2000 was 336 mm, and the average temperature in the same historical period was 17.8°C. In 2002, the rainfall was 263 mm and the average temperature was 18.5°C with the maximum of 37.5°C and the minimum of 3°C (Ministry of Agriculture, Fishery and Food 2005). Despite the good climate, the good quality of the soil and the fact that products commercialization is sorted out, Juárez (2004) points out that agricultural development has been restricted due to water shortage.

Because of the hydrographical, geomorphologic and climatic determining factors, the main Valencian rivers are allochthonous, that is, their headwaters originate from outside the region itself. They are rivers with highly anthropised fluvial systems, with a high regulation level and serious problems of contamination in lower sections. In general, the surface water supplies 68% of the water resources available in the Valencian Community (Rico 2002). The studied regions are placed in two different hydrographical

basins: *Vega Baja* is in the *Segura* basin, and *Bajo Vinalopó* in the *Júcar* basin.

According to the Hydrological Plan of the *Segura* basin (Ministry of Environment 1999a), the studied area comprises different agricultural demand units (ADU) that include the whole *Vega Baja* and part of *Bajo Vinalopó*. The latter, although included in the *Júcar* basin, receives a great part of its irrigation water from the *Segura* basin.

As stated in the Hydrological Plan of the *Júcar* basin (Ministry of Environment, 1999b), the region *Bajo Vinalopó* is included in the *Vinalopó-Alacantí* exploitation system. This system comprises the basins of the rivers *Monnegre, Rambla de Rambuchar* and *Vinalopó* and the coastal basins between the north boundary of *El Campello* township and the watershed with the Hydrographical Confederacy of the *Segura* River. Any agricultural development that receives water only from the Hydrographical Confederacy of the *Segura* River is excluded from this Exploitation System.

Rico (2002) considers that the River *Segura* provides about 179 hm^3 per year to Valencian land, mainly to *Vega Baja* and *Bajo Vinalopó*. Such volume includes un-purified sewage, livestock waste and irrigation turns where it is common to find heavy metals and a high concentrations of nitrate and chloride.

Other water source in the studied regions is the Tagus-Segura water transfer. It corresponds with the infrastructure called post-transfer, particularly with the left bank of the canal that starts in the *Azud de Ojós* (Murcia). This canal is divided into two: one goes to the north-east towards *Crevillente* (*Alicante*), within the *Vinalopó* region; and the other goes to the east towards the reservoir *La Pedrera* in *Orihuela* (*Alicante*), within the *Vega Baja* region. The average amount of water transferred from 1979 to 2001 through this aqueduct was 321 hm^3 per year. This figure refers to the total transferred to the provinces of *Murcia, Almería* and *Alicante*.

The Tagus-Segura water transfer also provides drinking water in the coastal zone of *Alicante* from *Alicante* to *Pilar de la Horadada* (*Vega Baja* region), whose distribution is done by the means of the *Canales del Taibilla*. In 2000, this entity distributed 194 hm^3 of which 141 were from the transfer, 44 hm^3 from the river *Taibilla*, 7.2 hm^3 from the river *Segura* and 1.8 hm^3 from the river *Júcar*.

The shortage of surface water resources and the demand boost during the second half of the 20th century caused the growing use of underground water. In the Valencian Community, Rico (2002) states that about 88% of towns and 55% of the population of *Valencia* get drinking water from the exploitation of aquifers, as it happens with more than 55% of the irrigated area. These usages together with some others, like industrial use, generate about 1 500 hm^3 per year of water consumption, which could be 2 000 hm^3 per year in case of drought. The general use of the excessive pumping has also produced the over-exploitation of many aquifers, with pronounced falls of piezometric levels and salinization of stored resources, either due to sea water intrusion or to triassic saline fronts invasion. On the other hand, it is frequent to find diffuse contamination processes by nitrates, chlorides, sulphates, carbonates, heavy metals, etc. that go beyond the limits established by the different communitarian regulations in the permeable surface systems which emerge in the intensive agriculture and cattle farm areas, and in urban and industrial areas. The hydro-geological unit of *Sierra de Crevillente*, where the studied areas are located, is one of the 15 over-exploited hydro-geological units in Spain (Ministry of Environment 2001). However, there is the problem of sea intrusion and the excess of nitrates in coastal aquifers, as it is the case of the coast of both studied regions.

The *Vinalopó* basin is, of the inland aquifers in *Alicante*, the one that suffers the most complex situation in terms of the use competition. Its water has been widely used since the end of the 19th century to attend the demands of the the companies of *Alicante*. Nowadays, there is a harsh competition between urban-touristy demands, managed by private companies, and the agricultural supplies of the region. From the underground phase of the hydrological cycle, 150 hm^3/year are used, of which about 90 hm^3 are from non-renewable reserves, collected in aquifers like the one in *Sierra de Crevillente*, 600 m deep, which engenders the extraction costs of 0.50 €/m^3. These data refer to the total of three *Vinalopó* regions: *Alto, Medio* and *Bajo* (Rico 2002).

The water shortage caused by draughts in 1981–1984 and 1991–1996 fostered several initiatives to obtain non-conventional resources, such as the re-use of sewage and the production of desalinated water. The most relevant re-usage initiatives took place in the regions *Bajo Vinalopó* and *Vega Baja* in *Alicante*, which re-used 70 hm^3 of the depurated water in 2002.

Desalinated water production is another non- conventional source which is getting a growing interest in the southern regions of *Alicante*, with a clear predominance of reverse osmosis systems. In 1995, 16 desalination plants of reverse osmosis were installed in *Vega Baja*, with the production capacity of 470 l/s of the net resource (Rico 2002). Production costs fluctuate between 0.50 €/m^3 and 0.85 €/m^3 for sea waters, and between 0.20 €/m^3 and 0.30 €/m^3 for salty waters (Prats 2004).

COMPETITION OF THE AGRICULTURAL SECTOR WITH OTHER PRODUCTION SECTORS

In the studied regions, the competition of the agricultural sector with other production sectors (especially industrial, residential and recreational) has been increasing since the 1990s in the last century to the present time.

Because of ecological factors and the historic occupation of the land, coastal plains are the main irrigated areas in the Valencian Community, generating harsh competition with other economic sectors like tourism, in what is called the Valencian useful space (Roselló 1990).

There is a common factor in the whole region regarding the irrigation space and water consumption: the destruction of agricultural land for urban and industrial purposes, both on the coast and inland. In regions of *Alicante*, like in *Vega Baja*, urban plans have usually been carried out to build large residential developments on small topographic ledges with good landscape perspectives (Navalón 2001). According to Rico (2002), the fall of productive irrigations has been spectacular in towns like *Torrevieja, Rojales* or *San Fulgencio* (towns of *Vega Baja*) with losses of more than 50% in the period from 1985 to 2000. The development of golf courses associated to residential and hotel resorts also prevails in numerous coast and inland towns.

Another fact is that Valencian irrigations are regressive in the historic fertile irrigation areas due to their closeness to towns and metropolitan areas with important expansion plans (Rico 2002). In the studied regions, the traditional fertile irrigation areas of *Vega Baja* and the river *Vinalopó* (in the town of *Elche*) are noteworthy.

The increase of population settlements in the studied regions has been very significant since the 1960s in large cities and since the last twenty years in the rest of towns. This increase is based on industrialization and development of an important tourist-residential building on the coast strip. Gozálvez et al. (1992) distinguish three types of periurbanization in accordance with building morphologies and usages: (1) tourist-residential on the coast strip for local and foreign owners, (2) single-family houses in the non-coastal areas for local owners; this periurbanization has been placed in tree-covered agricultural land, (3) industrial and tertiary sectors estates on the main roads which start in the city centres.

In *Bajo Vinalopó*, it is worth mentioning the town of *Elche* with an important industrial sector. According to the data by the municipal company, the industrial land in this town is more than 7 million of m^2 in 2006, of which about 3 million are still in process of development. Together with *Elche*, *Crevillente* is another important support in industrial development in the south of the province of *Alicante* (Sebastiá 1994).

The industrial development model in *Vega Baja* has been linked to that of *Bajo Vinalopó* to the extent that some of the companies originally from this region have been installed in the other. Together with the industrial sector, the building sector and its derivatives are the principal engines for economic development in these regions. In *Vega Baja* in 1991, activities related to metal products manufacturing and construction materials gathered up to 22% of industrial investment, food industry and textile fabrics meant 10%, wood and furniture sectors reached 15%, and shoes were 14% of the investment. According to the data from the Spain's Business Tax of 1993, the higher number of companies belonged to wood and furniture sectors (28.2%), food (25.2%) and shoes (17.2%). From the data of business taxes of 1996 analysed by the the Chamber of Commerce, Industry and Navigation of Alicante, it was estimated that 75% of the total secondary sector depends on the sectors already mentioned, 14% depends on metal and non-energetic mineral transformation companies, and the remaining 10% on chemical industry (Rodríguez 2000).

In this same area, the development of secondary and tertiary sectors caused an increase in industrial and residential land use to the detriment of agricultural use. Thus, the same author distinguishes three types of industrial land: industrial estates, industrial areas and industrial enclave. The first ones are perfectly planned areas with characteristics complying with the current urban regulations and good infrastructure. They are usually part of the partial or special plans of inland reform. Industrial areas are made up of zones that have gradually been built in urban land and they have equipment and infrastructure deficiencies. Industrial enclaves are large industrial resorts and facilities built around these, which have a little chance of extension. Table 6 shows the evolution of industrial land development in *Vega Baja* from 1995 to 2000. The percentage of industrial land is expressed in terms of the total of the municipal area.

Another land use is residential and recreational. Most towns in the studied regions have significantly increased the amount of land for these uses. This important increase in industrial, residential and recreational land use is made clear if we consider the data from the urban plans developed from 2000 to 2004. In several towns of *Vega Baja* and *Bajo Vinalopó*, the General Urban Organization Plans are currently in the claim period.

On the other hand, Navalón (2001) notices that in the whole Valencian Community and in particular on the coast of *Alicante*, the organization instruments suggested by the Autonomous Administration (for example in the Tourism Organization Plans) are not in the Territorial Coordination Plans, the General Urban Plans and the subsequent Partial Plans. As a consequence, the land areas suggested have been surpassed in a lot of the towns of the studied regions. And as a result, the population settlement has caused the urbanization of 56% of the Valencian coast and more than 80% of the *Costa Blanca* in *Alicante* (Vera 2001), where the studied regions are placed. Taking one kilometre of width from the seaside as the spatial reference, urban land is 33%, building land means a 23%, and the protected green belts non-building land is only 24% (Vera, Ivars 2002).

Moreover, urban and tourist areas are not subject to any territorial organization instruments which make urban development viability depend on water

Table 6. Industrial land evolution in Vega Baja (period 1995–2000)

	Municipal area land	Industrial land (1995)		Industrial land (2000)	
	ha	ha	% of municipal total	ha	% of municipal total
Albatera	6 632.60	85.24	1.29	88.90	1.34
Algorfa	1 872.00	9.04	0.48		
Almoradí	3 150.00	6.00	0.19	50.95	1.62
Benejúzar	921.00	17.49	1.90	10.60	1.15
Benferri	12 190.00			12.41	1.02
Benijófar	439.00	1.51	0.34	3.51	0.80
Bigastro	426.70	15.63	3.66	20.05	4.70
Callosa de Segura	2 747.60	15.00	0.60	23.61	0.95
Carral	1 985.00	18.74	0.94	25.95	1.31
Cox	1 660.00	20.00	1.20	42.30	2.55
Daya Nueva	602.00				
Daya Vieja	296.70				
Dolores	1 810.00			25.00	1.38
Formentera	424.70				
Granja de Rocamora	679.00				
Guardamar	4 100.00	17.20	0.42	110.72	2.70
Jacarilla	1 200.00	4.08	0.34	4.28	0.36
Los Montesinos	1 500.00			29.90	1.99
Orihuela	36 554.00	82.41	0.23	134.19	0.37
Pilar de la Horadada	7 810.70	14.52	0.19	24.90	0.32
Rafal	1 600.00				
Redován	919.90	25.73	2.80	59.68	6.49
Rojales	3 230.00			13.25	0.41
San Fulgencio	1 900.00	27.52	1.45		
San Isidro	677.40			14.20	2.10
San Miguel de Salinas	5 776.30	3.17	0.05		
Torrevieja	7 240.00	76.88	1.61	85.80	1.19
Total	97 101.20	440.16	0.45	780.20	0.80

Source: Rodríguez 2000

availability. In the Valencian Community, and in particular on the coastal strip, towns took urban planning as a conventional strategy to answer the demands of land for residential purposes, and no territorial strategies or development schemes are mentioned (Modrego 2000). In the autonomic organization instruments (Territorial Action Plans, General Plans, Partial Plans, Inland Reform Plans), it is made clear that the potable water resources are not an essential factor in urbanization. There is only the reference to the general water infrastructures (supply, drainage and purification) but there is nothing on the use restriction during the rainfall shortage or on the Draught Emergency Plans (Rico 2002).

CONCLUSIONS

The studied regions are traditionally agricultural zones where the growing of citric fruit, above all in *Vega Baja del Segura*, fruit and vegetables is very important. They are irrigation, intensive crops with important water needs. The two main problems these areas face are the shortage of water resources and prices, since prices received by farmers do not compensate the cultivation costs. Besides, the prices have been noticed to keep stable at best.

Agricultural activity is questioned nowadays in these areas. A great restructuring of the sector is needed. Particularly, this aspect is not tackled enough by the involved agents.

Another problem is the competition for land and water use with other sectors like the industrial, residential and recreational, since these regions have significantly increased the amount of land for these uses and what is more, it is still on the increase. Urban plans should be subject to limits depending on water availability in order to be able to face the future consumption.

A series of actions are needed to optimize the available water offer and rationalize the demand management, such as re-use of sewage water with tertiary treatments and modernization of irrigation systems (trickle irrigation, energy saving, etc.) in order to increase the water use efficiency.

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