



LIFE Environment and Resource Efficiency

LIFECITRUS

LIFE14 ENV/ES/000326

**C3 Study of the socio-economic impact of
the project**

18 July 2018.



Report prepared by **Grupo Foro Innovación y Tecnología S.L**

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1. INTRODUCTION

1.1. Overview of the LIFECITRUS project

At present the high development of the industry leads to the generation of waste, as well as to the improvement and implementation of new techniques or methods for their use. In the food production process, in addition to the desired product, by-products, residues and non-standard products are generated, each of which can be used for human or animal consumption and industrial application, which would bring economic benefits. Considering this framework, a new project has been funded under the LIFE programme. LIFE is the EU's financial instrument supporting environmental and nature conservation projects throughout the EU.

The project "Recycling by-products of the citrus industry in natural additives for the food industry", with the acronym LIFECITRUS (LIFE14 ENV/ES/000326), is coordinated by the National Technology Center for Canning and Food (CTC) and has the collaboration of the AMC business group and the AGROFOOD Cluster, located in the Region of Murcia (Spain). Another partner is the Italian Federation of the Food Industry (FEDERALIMENTARE SERVIZI), located in Rome.

This project is due to the concentration of the citrus production in the Mediterranean region, and to the generation of by-products of the industrialization of the same. It can be said that Spain represents almost 60% of the total production of the EU-28, followed by Italy with around 30%. In addition, Spanish production is concentrated in the regions of Murcia and Valencia.

On the other hand, the European citrus sector is strongly oriented towards the fresh produce market. However, the production of citrus juice (especially orange juice) is heavily implanted because of modern consumption habits versus the consumption of whole fresh fruits. This agro-industry generates a significant amount of waste, with the following fluctuation in the Region of Murcia:

- From 80,000 to 140,000 tonnes / year of lemon residues
- From 80,000 to 170,000 tonnes / year of orange residues
- From 30,000 to 50,000 tonnes / year of tangerine residues

This residue is the fruit discarded by low quality, but especially it consists of the parts of the fruit without commercial value (peel) that are removed during the process of transformation. Their

management through direct use in animal feed classifies them as by-products, but this solution is not compatible with advanced scientific and technical criteria.

The LIFECITRUS project proposes as a solution the implementation of an innovative process that the CTC has tested in recent years on a laboratory scale in a positive way. It is a process based on physical operations to obtain a new ingredient of application in the food industry. This product can be used as a natural ingredient, with exceptional properties, which can substitute for additives such as pectins, antioxidant acids, etc. in the production of jams and other foodstuffs (vegetable purees, sauces, ice creams, etc.).

1.2. Context

Currently, economic development and environmental protection are together. Nowadays, any industrial activity is carried out with reducing its environmental impacts. This is due to that in recent decades, the pressure exercised by different sectors of society and by the different administrations, is translated into the development of a comprehensive legislation to protect the environment. All that has meant that companies from all industrial sectors have significantly improved the environmental quality of their production processes taking into account that their activity must be carried out in benefit of the environment where the activity is carried out and therefore of society as a whole, but also for the benefit of the company. The economic results of the companies are linked to its image with respect to the environment that consumers perceive. However, in Spain almost 75% of the companies are SMEs that do not have the technical or economic capacity, for an easy integration of the environmental variable in their business structure, but they have to be conscious of reality and adopt technological solutions. These solutions can even add value to your company, making the most of their by-products for produce new ingredients, that can enrich new foods. In addition, new companies can be created in areas with market potential and a distribution system that guarantees business and environmental success.

As a consequence, the follow points must be taken into account:

- In the Region of Murcia the agrofood sector is closely linked to the fruit and vegetable processing industry and produce a potential valuable by-product, and therefore can generate wealth for the area.

- The creation of companies is one of the main indicators of country's economic activity. With more companies, will be more employment, more public income and more possibilities of increasing the economic and social development of all citizens.

- From the geographical point of view, Region of Murcia is a peripheral region with respect to the main centers of transport and economic activity of the EU. Also, Region of Murcia is part of the Mediterranean Arc, therefore have great potential for development and favorable enclave for the location of economic activity.

Food and Beverage Manufacturing Industry

The food sector is the first industrial sector in Spain. This sector is the key to the growth of employment, the production process and the exports business. It is an industry that employs more than half a million people directly, which contributes 3% to the Gross Domestic Product (GDP) and represents Spain in the world. In 2016, the *invoice of this sector was 102,313 million euros*, with an increment of 2.9%, more than twice the growth experienced in 2016 which was 1.3%. This increment was due to exports, which reached 9% (data provided by the Federation of Food and Beverage Industries (FIAB), 2017 report). In addition, Catalonia, Andalusia, Castilla y León, Valencian Community, Castilla La Mancha, Galicia and the Region of Murcia are autonomous region provide the greatest value to net sales of food products industry, with more than 76% of the total food industry (INE ,2015). (Picture 1).

TERRITORIAL DISTRIBUTION. Distribution territorial first three Autonomous Communities

NET SALES (% of de sector total)	OCCUPIED BY AUTONOMOUS COMMUNITY (% of de sector total)	ADDED VALUE (% of de sector total)
REGIÓN DE MURCIA (23%)	REGIÓN DE MURCIA (19%)	COMUNIDAD VALENCIANA (19%)
COMUNIDAD VALENCIANA (19%)	COMUNIDAD VALENCIANA (19%)	ANDALUCÍA (18%)
ANDALUCÍA (18%)	COMUNIDAD FORAL DE NAVARRA (13%)	COMUNIDAD FORAL DE NAVARRA (17%)

Source of information: Structural Statistics Companies of Industrial Sector 2015 (31/12/2015). INE

Picture 1.- *Percentage of sales, occupation and added value of fruit and vegetable preserves subsector, compared to the sector's total (MAPAMA, 2018).*

On the other hand, in the economic structure of the European food industry, Spain occupies the 5th place with 9.9% and 9.6% in volume and added value and reaches a volume of 1.5% of the total of the Industry of the European Union. These update data are according to report prepared

by the General Subdirection of Analysis, Prospective and Coordination of the Ministry of Agriculture, Food and Environment in September 2017. In addition, Spain ranks 5th in the European Union in terms of employed persons, after Germany, France, Poland and Italy, with a total of 353,417 (8.1% of the EU) (Picture 2).

DATA ON THE ECONOMIC STRUCTURE OF THE FOOD INDUSTRY*2

Industrial Company Survey 2014	SPAIN			EUROPEAN UNION*			% SPAIN EUROPEAN UNION		
	Volume of business	Value added	People in work	Volume of business	Value added	People in work	Volume of business	Value added	People in work
Units: Thousands of euros, people									
Meat industry	22.538	4.171	83.250	214.929	32.742	903.149	10.5	12.7	9.2
Fish processing industry	4.607	792	18.372	25.940	4.882	113.384	17.8	17.7	16.2
Preserved foods of fruits and vegetables	9.074	1.571	31.098	66.309	13.473	257.072	13.7	11.7	12.1
Fat and oils	12.008	1.078	12.450	52.809	4.416	61.485	22.7	24.4	2.2
Dairy industry	9.325	1.538	23.778	148.996	20.831	353.203	6.3	7.4	6.7
Grain mill products	3.345	471	5.839	46.901	7.678	106.540	7.1	6.1	5.5
Bread, bakery and alimentary pasta	7.082	2.453	76.008	115.557	41.055	1.491.017	6.1	6.0	5.1
Other products	11.881	2.688	46.558	162.337	37.349	605.977	7.3	7.2	7.7
Animal feed	9.656	948	11.655	78.589	10.059	126.317	12.3	9.4	9.2
Wines	6.188	1.624	24.248	29.707	6.291	98.377	20.8	25.8	24.6
Other alcoholics drinks	4.164	1.326	9.501	63.454	17.623	132.492	6.6	7.5	7.2
Water and alcoholics drinks	4.878	1.001	10.660	43.666	9.728	112.462	11.2	10.3	9.5
Food industry	104.744	19.661	353.417	1.049.192	205.526	4.361.475	10.0	9.6	8.1
Total industry	455.945	97.577	1.724.072	6.991.928	1.670.146	29.695.980	6.5	5.8	5.8

Source of information: Eurostat. Last available data: 2014. Data updated to September 2017.

*Data not available for all EU member states.

*2 definitions of industry structure data (end of the document pag 21)

Picture 2.- Economic structure of the European food industry. Subdirection General for Analysis, Prospective and Coordination of the Ministry of Agriculture, Food and Environment

European employment data indicate that Spain is the 4th country in the EU28 in number of employed in the primary sector after Romania, Poland and Italy. In addition, the employment people are between 25 and 49 years of age, being men the main employed, and with about 5% of the difference between Spain and the EU28 (Picture 3).

Year 2016	Labour Force Survey release (thousands of people)	15 years or more	Age group(years)				
			15 to 24	25 to 49	50 to 64	50 to 64	75 o more
SPAIN	Primary sector	774,6	42,9	462,0	256,7	11,5	1,5
	Foods and drink industry	478,6	22,8	328,0	125,1	2,7	0,0
	TOTAL	18.341,7	820,3	12.232,4	5.146,9	138,7	3,4
UE-15	Primary sector	4.857,1	332,7	2.302,2	1.778,3	343,6	110,3
	Foods and drink industry	3.701,2	379,9	2.263,9	1.002,8	46,9	7,7
	TOTAL	178.569,4	15.472,9	105.814,0	52.969,5	3.849,8	463,2
UE-28	Primary sector	9.555,1	668,6	4.750,3	3.317,0	693,1	126,1
	Foods and drink industry	5.062,2	483,0	3.181,1	1.331,7	57,3	9,1
	TOTAL	224.173,4	18.426,2	135.643,2	64.826,0	4.784,0	494,0
Year 2016	Labour Force Survey release (proportion of the entire)	15 years or more	Age group(years)				
			15 to 24	25 to 49	50 to 64	50 to 64	75 o more
SPAIN	Primary sector	100,0	5,5	59,6	33,1	1,5	0,2
	Foods and drink industry	100,0	4,8	68,5	26,1	0,6	0,0
	TOTAL	100,0	4,5	66,7	28,1	0,8	0,0
UE-15	Primary sector	100,0	6,8	47,3	36,5	7,1	2,3
	Foods and drink industry	100,0	10,3	61,2	27,1	1,3	0,2
	TOTAL	100,0	8,7	59,3	29,7	2,2	0,3
UE-28	Primary sector	100,0	7,0	49,7	34,7	7,3	1,3
	Foods and drink industry	100,0	9,5	62,8	26,3	1,1	0,2
	TOTAL	100,0	8,2	60,5	28,9	2,1	0,2
Year 2016	Labour Force Survey release (Thousand people)	15 years or more	Sex		Proportion of the entire %		
			Mens	Womens	Mens	Womens	
SPAIN	Primary sector	774,6	596,0	178,6	76,9	23,1	
	Foods and drink industry	478,6	303,6	175,0	63,4	36,6	
	TOTAL	18.341,7	10.000,8	8.340,9	54,5	45,5	
UE-15	Primary sector	4.867,1	3.468,7	1.398,4	71,3	28,7	
	Foods and drink industry	3.071,2	2.188,8	1.512,4	59,1	40,9	
	TOTAL	178.569,4	96.195,8	82.373,6	53,9	46,1	
UE-28	Primary sector	9.555,1	6.352,7	3.202,5	66,5	33,5	
	Foods and drink industry	5.062,2	2.915,9	2.146,3	57,6	42,4	
	TOTAL	224.173,4	121.250,3	102.923,3	54,1	45,9	

Source of information: Eurostat. Labour Force Survey (LFS)

Note: The data of employees from Eurostat don't coincided exactly with INE data because INE publishes the employees of 16 years old or more, while in Eurostat they also included of 15.

Picture 3.- Survey of the active population Spain 2016. Source: Eurostat 2018

In Spain, there are 23,769 food industry, according to data of Central Directory of Companies of the INE on January 2018. And more specifically, 1,423 food companies carry out their activity in the preparation and fruit and vegetable preserve subsector. It represents about 6% of the

Spanish food industry. This annotation is due to the fact that, juice and nectars industry is growing thanks to the search for new markets and innovation.

In Spain there are 1.5 million hectares of fruits and vegetables crops, which 38% is for the cultivation of vegetables and 34% for the citrus fruits crops. The tendency has been increasing slightly up to reach 299,518 hectares during the last decade, in 2015, according to MAGRAMA 2015 data.

On the other hand, in the other regions of the world the citrus fruits crop is very popular; in fact, the world annual production of citrus exceeds 100 tons and the oranges production exceeds 50% according to FAO data, 2017. In the European Union there is an estimated production of 11.7 million tons and it is concentrated in the Mediterranean region. Spain and Italy represent almost 80% of the total EU production. Citrus fruits are highly consumed in all the world as fresh products and juices. It has interesting characteristics and contains active phytochemicals that can protect health.

Spain produce more than 3,600,000 tons. Valencian Community and Andalusia are the main producers, with Murcia in third place.

On the other hand, the production of lemon is around 975,000 tons. 75% of these productions goes to fresh market and the rest goes to transformation. This production is concentrated in Murcia, Valencia and Andalusia, and occupies about 40,000 hectares. In addition, the sales of this sector industry are 688 million euros and create 20,000 jobs for people. Also, the export of fresh lemons reaches 80% of the total.

The mandarin crop is less widespread, but in recent years the production of mandarins has grown in the main citrus producing areas.

On the other hand, the manufacture industry of oranges, lemons and tangerines juice is considered a key part of the Spanish citrus sector, which focuses on the marketing of fresh juices. According to information from ASOZUMOS, (Spanish Association of Juice Manufacturers) in Spain there are approximately 50 companies that produce juices and nectars for the national market and export to other countries. The 31% of consumers prefer orange juice rather than other flavors, followed by pineapple juice (18.7%), peach (17.5%), multifruit (16.5%) and apple (4 %). In 2016 830.82 million liters was consumed and the consumption per capita was 17.9 liters/ person, according to data from the annual report on the sector of AIJN.

Food Industry in the Region of Murcia

According to Smart Specialization Strategy report of the Region of Murcia (RISMur, 2014), the agrofood industry is the first strategic sectors to go towards a model of economic and social development based on the competitive advantages of our Region. Agrofood industry is leader in R & D & I and have significant percentage of employment.

However, the net sales of food products place the Region of Murcia in seventh place, according to the most recent data of the INE (Picture 4) and in first place with respect to sales of fruit and vegetable products (Picture 5).

SALE OF PRODUCTS OF THE FOOD INDUSTRY BY AUTONOMOUS COMMUNITIES						
(Thousands of €)						
Autonomous community	Years				Variations (15/14)	
	2014	% s/FI	2015	% s/FI	Absolutes	%
Andalucía	13.123.578	14.1	13.945.002	14.2	821.424	6.3
Aragón	3.379.238	3.6	3.763.230	3.8	383.992	11.4
Principado de Asturias	1.768.457	1.9	1.643.842	1.7	-124.625	-7.0
Islas Baleares	530.800	0.6	505.714	0.5	-25.086	-4.7
Canarias	1.137.195	1.2	1.142.934	1.2	5.739	0.5
Cantabria	1.226.638	1.3	1.194.340	1.2	-32.298	-2.6
Castilla y León	9.370.142	10.0	9.191.680	9.4	-178.462	-1.9
Castilla- La Mancha	6.468.141	6.9	6.748.802	6.9	280.661	4.3
Cataluña	21.261.111	22.8	22.558.818	23.0	1.297.707	6.1
C. Valenciana	7.993.511	8.6	8.591.218	8.8	597.707	7.5
Extremadura	2.112.053	2.3	2.493.009	2.5	380.956	18.0
Galicia	7.157.822	7.7	7.123.191	7.3	-34.631	-0.5
C. de Madrid	4.458.103	4.8	4.736.961	4.8	278.856	6.3
R. de Murcia	5.731.674	6.1	5.799.492	5.9	67.818	1.2
Navarra	2.684.539	2.9	2.988.345	3.0	303.806	11.3
Pais Vasco	3.352.007	3.6	3.917.775	4.0	565.768	16.9
La Rioja	1.609.138	1.7	1.781.019	1.8	171.881	10.7
Total Food Industry	93.395.613	100	98.163.404	100	4767.791	5.1
Total Industry	454.966.257		452.921.464		-2.044.793	-0.4

Source of information: data prepared by the General Secretary of Industrial Development and Innovation of the MAPAMA (GD of Food Industry) from the data of the structural statistics of the industrial sector of the INE (Years 2014/2015 data to 31-XII-2014/2015). Note: data is not collected for Ceuta and Melilla.

Picture 4.- Sales of products of the food industry by Autonomous Communities. Annual report of the Spanish food industry period 2015 - 2016. Ministry of Agriculture and Fisheries, Food and Environment. General Direction of the Food Industry

REGION OF MURCIA

DATA OF THE MAIN INDICATORS OF THE FOOD INDUSTRY IN THE REGION OF MURCIA, BY SUBSECTORS. YEAR 2015

SUBSECTORS	EMPLOYEES		PRODUCT SALES		PURCHASE, RAW MATERIALS AND SUPPLIES		GROSS INVESTMENT IN TANGIBLE GOODS	
	Num.	% Total s/ F. I	Millions €	% Total s/ F. I	Millions €	% Total s/ F. I	Millions €	% Total s/ F. I
Meat industry	5.394	26.9	1.199	20.7	759	19.8	50	23.8
Fish processing industry	331	1.6	98	1.7	78	2.0	1	0.6
Preserved foods of fruits and vegetables	6.191	30.8	2.020	34.8	1.214	31.6	67	32.0
Fat and oils	208	1.0	840	14.5	806	21.0	4	1.7
Dairy industry	493	2.5	99	1.7	72	1.9	3	1.5
Grain mill products and starches	117	0.6	58	1.0	47	1.2	1	0.5
Bread, bakery and alimentary pasta	2.078	10.3	86	1.5	30	0.8	13	6.1
Sugar, coffee, infusions and confectionery products	1.356	6.8	219	3.8	107	2.8	21	9.8
Other products	2.633	13.1	726	12.5	425	11.1	24	11.4
The feed products	354	1.8	204	3.5	169	4.4	4	1.9
Wines	524	2.6	108	1.9	59	1.5	20	9.7
Spirit drinks	187	0.9	68	1.2	30	0.8	1	0.3
Other alcoholic drinks	0	0.0	0	0.0	0	0.0	0	0.0
Flavoured drinks and bottled water	0	0.0	0	0.0	0	0.0	0	0.0
Total F.I Murcia	20.080	100.0	5.799	100.0	3.840	100.0	210	100.0
Total Industry Murcia	64.849		16.949		11.079		619	

Source of information: data prepared by the General Secretary of Industrial Development and Innovation (GD of Food Industry of the MAPAMA), from the data of the structural statistics of the industrial sector of the INE 2015 (Data to 31-XII-2015).

Picture 5.- Main indicators of the food industry in the Region of Murcia, by subsectors. Year 2015. Structural Statistics of Companies industrial sector 2015 of the INE. General Directorate of the Food Industry-Ministry of Agriculture and Fisheries, Food and Environment.

1.3. Strategy

The strategy has been based on the valuation of the project under the economic, business and technological environment of the Region of Murcia, which is an Autonomous Community of Spain and belongs to the European Union. This Project has developed a new ingredient with application in the companies of the Region of Murcia. Moreover, the project has increased the scientific knowledge of Spanish institutions to continue working on the promotion of scientific, technological and business leadership of the Spanish R&D+I System at international level.

To carry out this study, first, we focus on agri-food sector, and specifically the horticultural (citrus) of the Region of Murcia, due to the main objective of project is the valorization of by-products from the citrus processing sector.

2. ECONOMIC SITUATION OF THE REGION OF MURCIA

The Region of Murcia is located in the southeast of the Iberian Peninsula. It has an area of 11,317 km², which represents 2.24% of the Spanish surface and 0.35% of the EU extension.

In 2017, Murcia was the fourth Spanish autonomy with the highest growth due to 30,344 million euros of its GDP. According to data from the Regional Statistical Center of Murcia (CREM), the GDP of the Region of Murcia registered an interannual variation rate of 3.6% in 2017, while for Spain was 4.0% (Picture 6). In 2017, there was an intense growth rate compared to the 2012-2014 period. Therefore, we could be in an economic recovery process after the crisis.

	2017	2016	2015	2014	2013	2012
MURCIA (Region of)						
GDP at market Price (current prices)	30,0343.856	29,171,155	28,211,500	26,611,576	26,479,434	26,547,688
GDP Year-on-year rates of change	4.0	3.4	6.0	0.5	-0.3	-2.6
GDP Per capita	20,585	19,865	19,270	18,191	18,122	18,168
GDP Per capita. Interannual variation rate	3.6	3,1	5.9	0.4	-0.3	-2.6
SPAIN						
GDP at market Price (current prices)	1,163,662,000	1,118,522,000	1,079,998,000	1,037,820,000	1,025,693,000	1,039,815,000
GDP Year-on-year rates of change	4.0	3.6	4.1	1.2	-1.4	-2.9
GDP Per capita	24,999	24,080	23,271	22,340	22,014	22,234
GDP Per capita. Interannual variation rate	3.8	3.5	4.2	1.5	-1.0	-2.9

Picture 6.- Evolution of Gross Domestic Product at market prices). Data from the Regional Statistics Center of Murcia (CREM) updated, March 23, 2018.

The dynamism industry of 2017 is one of the strongest points of the regional economic situation. Probably, this is the reason for Keep up the economic growth like two previous years.

At regional and national level there are a lot of utility company, but there are a big agrofood industry, like ElPozo, García Carrión, Zukán, Garsan, Cefusa and Ecoagrícola.

On the other hand, the year 2017 was affected by the watershortage. This fact was directly reflected in horticultural productions. The production of same varieties went down and the quoted rate not go up. On the other hand, there were upswings in the quotes that could offset the decline in harvests. In the campaign of stone fruit, the prices were far from price in 2016. Neither the citrus fruit price in 2017 was higher than in 2016. Apart from this, in 2017, the regional exports were favorable, with a growth of 9% (CREM data) with respect to juices, and sugars and confectionery exports. In total, the external sales of the Region of Murcia exceeded 10,000 million euros in 2017.

In conclusion, the current economic is improving, but we must work on the innovation to have an economy able to give added value to our resources.

Innovation must be incorporated in all areas of the economy; not only technological innovation, also innovation in management, products, processes, utilities etc. In addition, we must work to promote cooperation, to ensure sustainable growth and the construction of a solid and competitive economic structure in the global market. These factors are determining if we consider our small managerial economics.

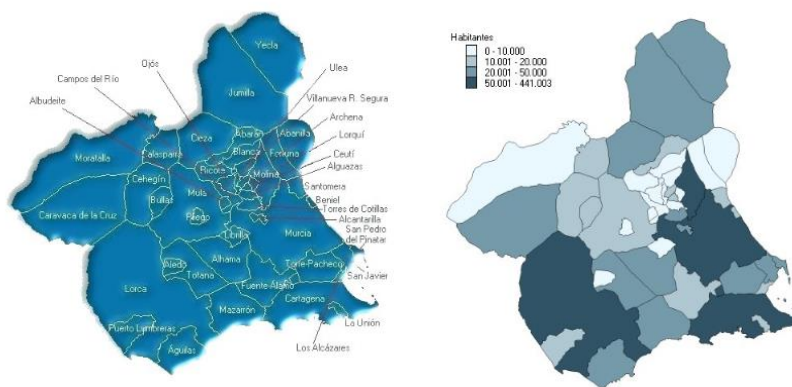
The agrofood sector have an economic and social impact, as a consequence of high quantity of employment people. The promotion of sustainable technologies can increase the profit from the companies, in spite of have costs of waste management.

On the other hand, the human resources employed (education, training, qualification, specialization, work experience, health) is a determining factor of economic development. The farmers and business owner of Region of Murcia has great entrepreneurial character and thanks to their great efforts Murcia is a reference in technological innovation and agrofood internationalization.

In addition, the creation of companies is one of the main indicators of the economic activity of a country. The more companies, more employment, more public income and more possibilities of increasing the economic and social development.

3. SOCIAL SITUATION OF REGION OF MURCIA

The Region of Murcia limits the north with the Autonomous Community of Castilla-La Mancha (province of Albacete); to the east with the Valencian Community (province of Alicante), to the south with the Mediterranean Sea, and to the west with the Autonomous Community of Andalusia (provinces of Almeria and Granada). It has connected by road, rail and plane with the rest of Spain and Europe. It is divided into 12 countries and 45 municipalities with a total population of 1,470,273 citizens, according to census of 2016. Among the municipalities of the Region of Murcia, the municipality of Murcia is the most populated with more than 440,000 registered people and follows by the municipality of Cartagena with around 215,000 people (Picture 7). This distribution of urban population offers an axial configuration due to the natural environment and economic activity. However, the territorial distribution of the population is very unequal. There are great contrasts due to both physical and cultural and economic conditions: irrigation, improved communications around the valleys of the Segura and Guadalentín rivers, proximity to the capital and industrial, mining and tourism activities (coastal areas).



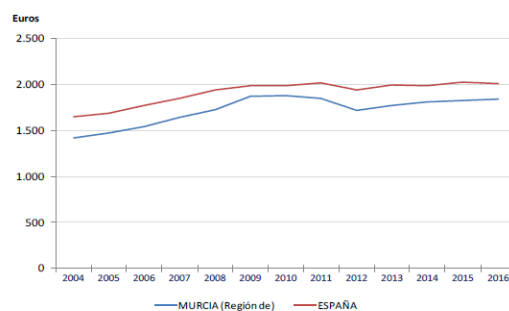
Picture 7.- Municipalities of the Region of Murcia and population map of 2016. Source: CROEM. STATISTICAL YEARBOOK OF THE REGION OF MURCIA 2016. VOLUME I. REGIONAL FIGURES

The districts of Huerta de Murcia, Campo de Cartagena, Mar Menor and Vega Media are the most developed in the Community: they are located in the first places of income and population and the second of surface area for irrigated crops. The High and Low Guadalentín areas have an average, with population densities between 50 inhabitants / km² and 100 citizens / km², lower than the regional average, irrigation occupies more than half of the cultivated field. The Region

of Vega Alta is quite populated and has abundant irrigation, but the citizens have a low income. The Altiplano area is not so populated and its fields is mainly dry land cultivation; However, its citizens have a high level of income. The regions of the Northwest, Río Mula, Valle de Ricote and Oriental have small population and some irrigations fields. The income levels of its citizens are the lowest in the Region of Murcia. Despite this situation, the Region of Murcia enjoys a strategic situation and is equipped with infrastructures that guarantee the quality of life of its society and a sustainable working market.

According to information available in the Bulletin of Economic Situation (No. 40) - March 2018 of CROEM (Regional Confederation of Business Organizations of Murcia), the economy of the Region of Murcia maintained a slight increase during 2017, that moved to the working market, the amount of unemployers decreased and some optimism was perceived. At the end of 2017, the Region of Murcia had 34 companies registered (+ 0.1%, by + 0.6% in Spain), and 2,641 new commercial companies (-4.9%, vs. -6, 6% in Spain), 247 d disappeared companies (+ 2.1%) and 131 bankrupt companies (+ 35.1%). Likewise, the “Business Confidence Index” showed high favorable opinions in January 2018 (27% of the total).

In conclusion, the economy of Region of Murcia is in a period of stable growing that has an impact on the working market, promoting an improvement. In terms of employments, 596,400 workers are estimated, 21,400 more than in 2016 (+ 3.7%). The problem is that the remarkable expansion has little effect on salaries (Picture 8).



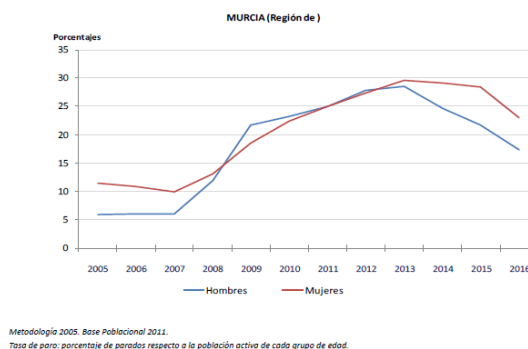
Picture 8.- Evolution of salaries cost per worker and month. Source: CROEM. STATISTICAL YEARBOOK OF THE REGION OF MURCIA 2016. VOLUME I. REGIONAL FIGURES

The 99% of companies in the Region of Murcia are SMEs or micro-SMEs (0 to 9 workers), employing two thirds of the workforce and generating more than half the volume of the total

income. This high degree of atomization places our business environment in a low position, especially in some sectors in which a minimum dimension is an essential requirement to be competitive or to go to internationalization or innovation processes.

Specifically, the agricultural food sector is a traditional sector in the Murcia economy, and an important generator of employment through SMEs, since around 93% of companies have less than 200 employees and are mostly concentrated in the Region of the Vega del Segura and the Northwest. Summarizing, the fruit and vegetable canning industry is characterized by its cluster structure in the Region of Murcia, due to a concentration of related companies in this geographical area, which generates employment for 6,191 people (latest data available in the National Institute of Statistics for 2015).

Regarding employment, the data for 2016 showed a growth compared to the previous year, that was quantified with a 562,000 employed and 529,800 employed in 2015. More than 34,000 people were employed at the end of 2015. The picture 9 shows the evolution of unemployed in the Region of Murcia.



Picture 9.- Evolution of the unemployment rate in the Region of Murcia. Source: CROEM. STATISTICAL YEARBOOK OF THE REGION OF MURCIA 2016. VOLUME I. REGIONAL FIGURES

At the end of 2017, the Region of Murcia has 121,900 unemployed, and 586,400 employed, according to data from the “Active Population Survey conducted by the National Institute of Statistics”. Comparatively, there were 8,600 fewer unemployed (-6.6%) and 14,800 more employed (+ 2.6%) than in the same period of 2016. Finally, the creation of employment benefited more the female (+9,600) than the male (+5,200), and people of more advanced ages (+12,800 employed persons over 54 years old, and +5,500 among the ages between 45 and 54

years old). In addition, the higher rate of employment in 2017 is explained by the higher rate of job creation in agriculture, construction and manufacturing.

In summary, the Region of Murcia accumulates four consecutive annuities of job recruitments. A high percentage of people who lost job since 2008 has been recovered, but it is still necessary to work in the job stability, promote the creation of companies, facilitate the development of business projects and strengthen the commitment to a more innovative economy.

Although all the regions of the Region of Murcia improve their employment rates, they do not occur with the same intensity: the creation of jobs is concentrated in the of Murcia municipality. As for municipalities in the districts it can be point out, for their work dynamism, Murcia, Lorca, Molina de Segura, Alcantarilla, Alhama De Murcia, Yecla, and Lorquí. While in the opposite, those that lose more employment are Albudeite, Archena and especially Cartagena.

A remarkable fact is that around 46% of the employment contracts in 2016 were of people under 35, more for men than women in all age range, especially in the age group between 35 to 44 years. and from 45 to 54 (72.22% and 69.81%), respectively. On the other hand, around half of those employees had a Secondary school level; 8.33%, medium or higher Vocational Training, and only 5.13% had a university degree, higher or equivalent to EEES (Bologna), of which, the latter account for 24.83%. Likewise, 24.10% lacked studies or these were not registered.

In addition, in 10.53% of the employment contracts made to job seekers in the Region of Murcia, they had stayed between six and twelve months registered as unemployed; 4.94%, between one and two years and 4.44%, more than two. These data have been obtained from the “Worker Market Report of the Region of Murcia” 2016, made by the State Public Employment Service in 2017 and its review can determine that specialized recruitment is not significant in the worker market of the Region of Murcia.

On the other hand, according to the report published by The World Bank (2015), the Region of Murcia is the third Spanish Region where it is more difficult to do business, and in which it takes longer to constitute an industrial SME (a businessman in Murcia must perform 7 procedures, taking 8 months, at a cost of 9.3% of the per capita income). Compared to other European countries, starting an activity with an industrial SME is more laborious, since in a consultation carried out in 2010, in the European Union a similar company could take half the time or less and cost even less than a third.

In the Region of Murcia, the agrofood value chain occupies a relevant position of "R&D+i leadership", it is not remarkable at a national level, but yes at a regional level due to the high scientific-technological production and the concentration of a significant percentage of employment in the agri-food sector. The sector of machinery for the food industry is a leading sector in the Region of Murcia, developed by the requirements of agri-food industry, mainly canning and high-quality horticultural and horticultural. It is a sector that offers tradition but with a good technological level and It is worked in aspects related to innovation and specialization, as well as internationalization.

The manufacturers of machinery for the agri-food industry of the Region of Murcia have a huge experience based mainly on their proximity to the important regional manufacturers of canned vegetables and juices and, to a lesser extent, those of paprika, cereals and feed; and also a technical capacity that allows them to design, build and implant advanced equipment and complete processing and packaging lines. In addition, the trend of the markets is to increase the intensive grows in countries of the Mediterranean basin with similar climatic conditions therefore. The machinery manufactures can commercialize their food processing technology to these countries, where are no companies that manufacture complete production lines. Also, the demands of society on functional and organic foods and environment sustainable process, produce clear trends towards technological renewal, innovation and applied research.

In this context, with the support of technological centers, the Murcia manufacturers of agri-food machinery have a high technological potential and the development of new products and markets based on their capabilities, experience and knowledge.

Lastly, the Murcia agri-food sector plays a fundamental role in the determination of the population in the rural environment, in the conservation of its environmental, landscape, cultural and gastronomic values and in social and territorial cohesion. This makes The Agri-food sector a strategic sector for the regional economy and fundamental for generating employment, wealth and welfare for the population. The occupations with the best medium and long-term prospects are those that provide added value and those linked to the economic activities of agriculture, tourism and commerce, which do not require high qualification. But, for the agri-food sector, it is necessary several levels of qualification such as: agricultural workers, workers of the manufacturing industries, fruit and vegetable canning workers, agronomists, qualified workers in agricultural activities and phytosanitary technicians.

The prospects of the agri-food sector in the Region of Murcia are quite promising, according to current trends. We are in an era in which it is common to renewal sectors, including the agrifood sector. The demands of consumers are increasing and are transferred to the whole agri-food chain. This affects all actors, so each link in the chain has to be in tune with the latest consumer trends.

4. AGROFOOD SECTOR OF THE REGION OF MURCIA. CITRUS SECTOR

As previously it has indicated, the agri-food sector is considered strategic for the Spanish economy and, especially, for the Region of Murcia, which produces 20 percent of GDP. In addition, Murcia was placed as the first exporting Spanish Region of fruits and vegetables, with 2.5 million tons exported in the year 2017, with a value of 2,364.95 million euros.

The economic activities carried out within the framework of the agri-food system, can be classified into five groups that are interconnected:

1. Industry of supplies and services to the agricultural and agri-food sector
2. Agricultural sector (agriculture and livestock)
3. Agri-food industry
4. Transport of agricultural and agri-food products
5. Distribution of agricultural and agri-food products

Because of its socio-economic importance and its contribution to rural development and the well-being of society, to analyze the agrofood sector, it will be divided into two: AGRARIAN SECTOR (agriculture, livestock and fisheries) and a FOOD SECTOR (food and beverage industry).

Agricultural fact. Agricultural holdings

The Region of Murcia has more than 300,000 hectares of land dedicated to the main cultivation of: citrus fruits, vegetables, non-citrus fruits (mainly almonds), flowers and ornamentals, whose production is highly conditioned by the severe limitation of water resources. The agricultural is dry and irrigated grow. The dry land extends to the south and north of the Segura River, northwest of the Community and by the Campo de Cartagena. In these areas the main crops are cereals, vineyards, almonds and olives. On the other hand, irrigated crops occupy the fertile

valleys of the Segura, Mula, Guadalentín and Argos rivers, with crops such as cereals (rice), tubers, industrial crops (cotton) and forage crops (alfalfa). Other irrigated crops are in Cartagena, Lorca, Abanilla, Mula and Cieza, where fruit crops (especially lemon trees) and vegetables represent more than 22,000 ha. Also, potato and table grape crops are located. The regional agricultural production is vegetables with the 46% of production, the citrus fruits 23%, the sweet fruit trees 16% and 7% for vineyards. The remaining 8% is distributed among other products.

The total grow area was 301,126 hectares in 2016 (in 28,833 farms), of which 189,000 hectares are used for woody crops such as almonds, citrus fruits, vineyards, olive groves and peach trees mainly. The area for citrus was near 38,000 hectares, according to updated figures available in the STATISTICAL YEARBOOK OF THE REGION OF MURCIA 2016. VOLUME I. REGIONAL FIGURES. The lemon fruit is the highest production with about 64 percent of the total amount, following by vegetables and tubers, such as lettuce, tomato, watermelon, broccoli, potato, melon, pepper and artichoke.

In addition, the Region of Murcia is one of the Spanish Regions with more area for organic crops. In 2016, the area of organic crops, certified by the Council of Organic Agriculture, was 79,043.95 hectares, with more than 31,000 organic agricultural manufacturers. These data placed the Region of Murcia in the top of organic farming, regarding to the cultivated area, which implies a great socio-economic and environmental development and investment.

Murcia citrus sector is important and has a strong exporting vocation, mainly of products destined to fresh consumption and with high quality, with lemon at the top. The citrus harvesting season depends with the citrus variety, although it is generally harvested from autumn until the end of May. The varieties *PRIMOFIORI (FINO)* and *EUREKA* lemon varieties are collected from October to February, while *VERNA* is harvest between February and May. *FINO* is a lemon variety with a thin skin and high content of juice, compared to *VERNA* with lower content of juice, some seeds and thicker skin.

These lemon varieties are high commercial value in the national and international market more than other varieties of lemon, such as tropical lemon, rich in sugars, bigger and thicker, but with lower acidity for fresh consumption. Lemon from Murcia is used to supply national fresh lemon demand and for exporting. The main importing countries are the United Kingdom, France, Poland and the Czech Republic. On the other hand, competitors for the Spanish citrus sector comes mainly from Morocco, Turkey, Egypt and to a lesser extent, South Africa and Argentina.

In fact, Morocco and Egypt have a national government support and have managed to increase their production to enter strongly into the European market.

Regarding to industrialization of lemon, the manufacturing of the lemon is variable, according to the latest figures in 15/16 and 16/17 season seem to indicate an increasement up to 161% in 2017. In the last season, 237,000 tons of lemons were processed by citrus industries.

Agricultural water use

In the Region of Murcia, the importance of the agricultural sector is based primarily on irrigation crops, Region of Murcia has the higher Surface of irrigated hectare of Spain (16%) with a total contribution more than 90% of the final agricultural production in Spain. Hence, the importance of having short, medium- and long-term water resources in quantity and quality to guarantee the development of the Region.

The Region of Murcia has a water deficit due mainly to the semi-arid climate, with scarce rainfall distributed irregularly in time and areas, so it can be said that it has a structural water deficit. Therefore, in the agri-food sector there is a culture of water based on the principles of efficiency and savings. The traditional irrigation systems have changed, oriented to more modern and advanced techniques within the framework of a policy of improvement and modernization of irrigation, and in the reuse of waters suitable for agriculture.

The Region of Murcia is leader in the use of state-of-the-art water technologies, as this scarce resource guarantees the survival of the sector. It should be noted that exports from the Region of Murcia are produced only with 3.7% of the irrigated water consumed in Spain.

The water resources available in the Region of Murcia for agriculture, according to their origin are: Regulated surface waters in the Segura river basin, Water contributed by the Tajo-Segura Transfer, Groundwater, Reclaimed water, Desalinated water. In relation to water management in the Region of Murcia, more than 350 irrigation communities manage most of the agricultural area. The “Communities of Irrigators” are associations of mandatory constitution of irrigators from the same concession of public water and they are entities of public right ascribed to the corresponding Basin Organization. The different origins and the seasonal variation of flows linked to these origins determine the existence of mixed waters distributed by these Communities. Thus, there are also different qualities of irrigation water according to location

and even season. For all this, it is very important to analyze the irrigation water before its use in the crops.

Food Fact. Manipulating and transforming industries.

In the Region of Murcia, the agri-food sector has traditionally a great weight within the industry of the Region and especially the preparation and manufacture of fruit and vegetables. This sector is well positioned in the national market and in the most demanding international markets.

Currently, fresh agricultural products are the core of a large-scale consolidated production system. The Region of Murcia has a high number of fruit and vegetable fresh transformers, canned vegetable and juice factories, with more than 6 million tons of production per year. This production supports its interesting sales figures.

The global turnover of fresh products is, according to harvest, around 3,000 million euros per year.

On the other hand, the fruit and vegetable canned subsector reached a product sales figure of 2,020 million euros, almost, 35%, from the regional food industry in 2015 (updated figures obtained from the Structural Statistics of Companies sector 2015 industrial by the SNI).

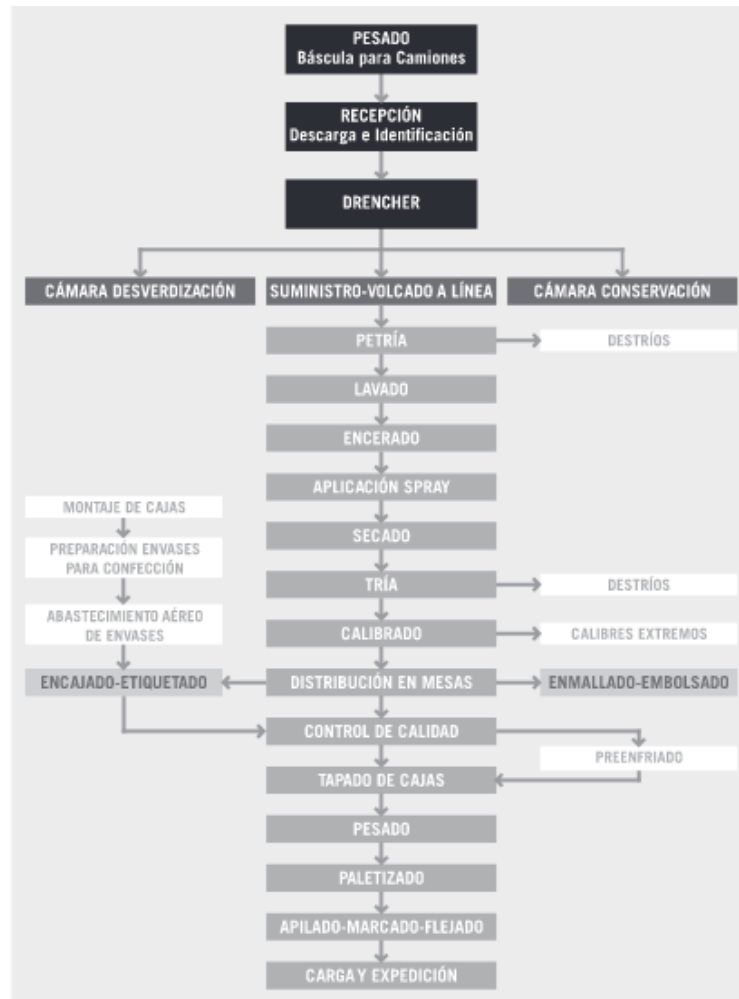
Fruit and vegetables fresh manufacturers

These actors are fundamental for the retail commercialization of the horticultural products since they allow the conditioning of the fruits and vegetables and their approach to the final consumer. They carry out a series of processes that include the collection of the product and its handling (selection, packaging, calibration, packaging, palletizing, etc.), as well as the logistic functions to make it available to its customers in the retail national markets and international.

In addition, the plants provide services related to traceability, quality protocols, transport to the factory, advice to farmers, transferring information regarding the market, training, supply of inputs, purchase guarantee, financial services, insurance, production planning, safety to the supplier on the price, machinery, research and development, processing of subsidies and even management of the workforce.

The fresh manufactures are responsible for putting the products on the market through an operator or with the industry they can deal directly or through a broker.

Citrus fruits are handled in numerous fruit and vegetable fresh manufacturers factory in the Region of Murcia in order to incorporate a series of characteristics to fresh products such as durability, invariability, standardization, differentiation, accessibility, etc., for their commercialization. Picture 10 shows the process of fresh citrus manufacture.



Picture 10.- Flow chart of lemon fresh manufacturing. Source: J. García García (2014). Analysis of the lemon sector and economic evaluation of its cultivation. IMIDA. Murcian Institute of Agricultural Research and Development and Food Ministry of Agriculture and Water of the Region of Murcia

The structure and creation of companies and associations depend of the geographical area and its habits, forms of production and products. Most of them are constituted as mercantile societies, cooperative societies and agrarian transformation societies (A.T.S.), with variable sizes.

In addition, this job in the manufacturing fresh industries demands a workforce characterized by an employment rule of great eventuality, which is perfectly adapted to the specific requirements determined by the transformation of production processes (persistence of seasonality and high flexibility productive and working times). This activity is mainly developed by women in a precarious wage and labor relationship, mostly temporary, which in some cases takes the form of a "fixed-discontinuous" stability. All this means that, in spite of having produced a technological innovation, the organization of work has not been modified, and the warehouses of the horticultural centers are the work place of people with a low salary.

These comments provide information to conclude that the agri-food sector, and more specifically, the citrus subsector, has a low socioeconomic level. The number of these companies in the citrus subsector is high, since they are usually dedicated to more than one product. These companies are included in the classification of the CNAE 2009 (463: Wholesale trade of food products, beverages and tobacco) and, according to the SNI, in 2017, there were 2,256 companies in the Region of Murcia. Therefore, it is an interesting number, which represents 5% of national food companies.

Canned fruit and vegetables / Juice production

Canned fruit and vegetables are those products that are producing to increase the shelf life of the food. For its transformation it is necessary to receive the raw material from the horticultural suppliers or from the field directly.

In Region of Murcia are registered 160 companies in the CNAE 2009, classification with the code 103 (Processing and preservation of fruit and vegetables), according to data from the SNI company's directory of 2017. These represents around 17% of the food companies of the Region of Murcia (a total of 958 food companies). These companies have a heavy weight in the regional industry and mainly develop the following steps to produce elaborated products.

First, when the raw material arrives at the factory, it is weighed at the reception step, to know the amount of fruit or vegetables for processing. At this time samples of raw materials are taken to determine if they reach the quality required by the company: size, maturation index, temperature during transport, foreign substances adhered, presence of harmful materials such as glass or metal, with the aim to control if the raw material is within the quality and safety parameters.

After that, the washing step is high importance to produce canned vegetables. The method depends on the type of fruit or vegetable that is processed. The main objective of the washing and / or cleaning is to remove soil and vegetable waste. At the same time, this process achieves a significant reduction in the microbial content of the raw material.

The following process steps depend on the type of fruit or vegetable, for example pear peeling, washing by immersion in tomatoes, etc.

The conditioning is the next step, different operations before the preparation of the canned and which differ for each fruit or vegetable, such as peeling, slicing, etc. The methods used to peel vegetables are classified as mechanical, chemical and thermal. The different ways for peeling differ from the type of fruit or vegetable. Many vegetables are not packaged with the same shape of the raw material, so a reduction size has to be done during industrial process.

Once the fruit or vegetables are cut, they undergo a classification, passing through vibrating belt that allow to separate the pieces or defective portions that do not reach the size and shape specified for the final product. When the vegetables are harvested, they undergo changes because of alterations, often initiated by the enzymes of the plant, which begin the decomposition of the vegetables. The time elapsed between the collection and the inactivation of the enzymes can be critical for the quality of the final product. To prevent enzymatic alteration, horticultural products receive a heat treatment with hot water or steam. This process is named blanching, the enzymes are inactivated in addition the occluded air in raw material is removed. This step avoids color changes and favoring the retraction of the product for an adequate filling. This operation must be carried out with great caution, since the main microbiological risk is the possible contamination of vegetables with spores of thermophilic bacteria as a result of a failure in the adequate cleaning of the cooker.

The inspection and visual selection of fruits and vegetables is the traditional way of eliminating waste from the production line such as skin remains, defective units for lack of consistency, uniformity of color, tears etc. It is made on ribbons or sets of rollers, before packaging.

Filling in glass or metal containers is done mechanically or manually. A perfectly controlled filling operation is essential in any packaging operation since the lack of control of this stage can involve risks for the quality and for the safety of the product. Hot covered liquids are added to containers after fruit and vegetables are packaged and before the operations of sealing, sterilization and cooling. The air evacuation of the containers is a critical factor to minimize

stress on container closures during heat treatment, preserve quality and reduce internal corrosion. These air remove can be done by steam injection in head space of the container before sealed or using vacuum closures machines.

Finally, to obtain a food free of microorganisms capable of multiplying under normal storage conditions, the industrial or commercial sterilization stage is carried out, which is a heat treatment that can be defined as the situation reached by applying enough heat, by itself or in combination with other appropriate treatments. When considering the heat treatment that different fruits and vegetables need, it is necessary to highlight the importance of the pH of the food to be bottled and the previous treatment that has been received.

It is important to point out that in the canning industry there are other technologies for packaging, which allow sterilized products before closed in sterile containers under aseptic conditions.

On the other hand, companies producing fruit juices and citrus are also important in the Region of Murcia. Juice or fruit juice is defined as the liquid obtained from fruits by physical processes, clarified or not by mechanical or enzymatic procedures, susceptible to fermentation, but not fermented, which possesses the characteristic color, aroma and flavor of the fruit's juices (sensorial characteristics) of the fruits they come from.

The fruit juices obtained through physical procedures of extraction of juices have common steps to the manufacture of stable of fruits and vegetables described above, and another different process depending on the final product (fruit juice, nectar, concentrates, purees, dehydrated, etc.).

Other process apply in citrus transformation are evaporation techniques to obtain a concentrate before the packaging and storage of the product. For dehydrated juice lyophilization or atomization is used to remove the water from the product. These operations facilitate the transport of the juice and only require the addition of the removed water to reconstitute the juice before packaged.

For production of nectar, before the conservation and packaging treatment, water and sugar are added to the fruit puree as ingredients. At a commercial level there is a wide variety of juices and nectars, which in turn is supplied with various raw materials, the most commercial juices and nectars are peach and apricot and citrus juices.

In general, for fruit juices, after the reception of the raw material (fruit), it must be washed and then conditioned to obtain the juice by peeling, cutting or pitting (this is not the case of citrus, which the juice is extracted after fruit washing).

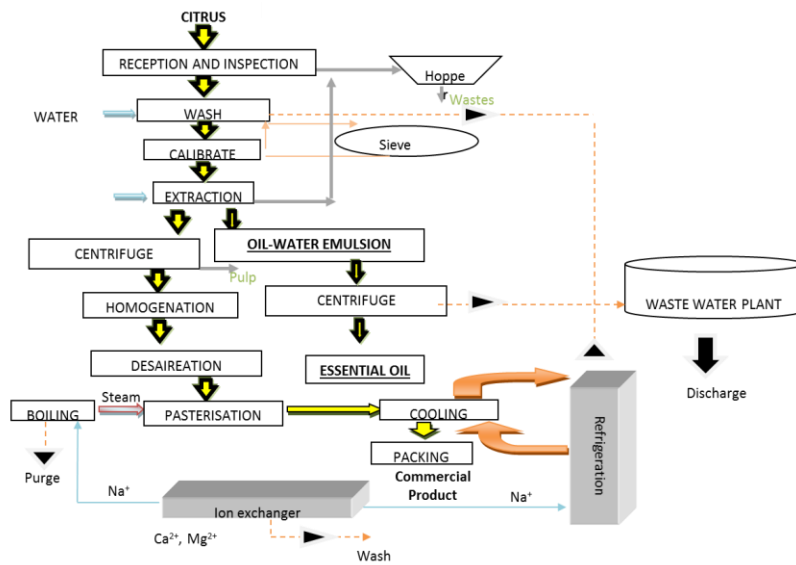
Then, the extraction itself takes place through different steps (crushing, finishing and pressing), which may or may not be simultaneously accompanied by finishing (pressing or centrifugation), and heating. These techniques are linked to the raw material processed.

Subsequently, the extraction of juice or pure go through different refining processes, such as decanting (precipitation by the addition of compounds that eliminate dissolved substances and subsequent extraction of sludge and sludge formed) and clarification-filtration (by various centrifugation methods and / or Subsequent filtration is intended to remove finer solids, such as protein and peptide substances in solution, which make subsequent filtration difficult).

Deaeration under vacuum conditions is also necessary to remove air of the product (this air can produce the enzymatic oxidation of the product). After that, the juice is pasteurized and storage for the commercialization of the product obtained.

In addition to the production of juices from seasonal fruit, they can also be obtained from fruit puree (process indicated in the previous sections). These purees, which are aseptically packed in the field, can be marketed throughout the year to produce juices. The process in this case starts from the puree of raw material and goes directly to the extraction step, where by pressing or centrifugation the juice is extracted.

The picture 11 shows the flow chart of citrus juice production including essential oils extraction from citrus processing.



Picture 11.- Flow chart of citrus juices process

The process for producing citrus juices consists first in the selection and washing of the raw material. The fruit comes from the silos or from the discharge tank and its transfer to a belt where it is washed and transported to the elevator that takes it to the processing plant where it is calibrated.

The washing step aims to eliminate all foreign bodies that may contaminate the juice. The fruit can also enter a washing machine and go under some sprinklers, which apply cleaning products to the fruit. In this case, the fruit circulates on rotating brushes that gently clean the surface eliminating dust and any other foreign substance. Afterwards the washing machine unloads the fruit in the calibrator.

The calibration of the fruit is necessary due to the sensitivity of the extractors with the diameter of the fruit for its right running.

The extractor system is called "in line" and performs in a same operation the extraction of juice and essential oil, without contact between them.

The fruit is supplied to the different extractors according to their size. The fruit is directed to the extraction cups individually. The fruit falls into the lower cup, which automatically centers and positions it for extraction. The upper part descends while the cups intertwine, applying pressure to the entire surface of the fruit, once the skin is separated.

The bottom of the lower cup contains a blade made of stainless steel that leads the juice to the strainer tube (pre-shaker). The blade makes a circular incision in the base of the fruit, and while the cups exert pressure inside the fruit is carried completely to the strainer tube (initial finisher), where the juice and pulp are separated instantaneously from the seeds and the membrane. Only the juice and the pulp go to the tank.

In addition, this in-line extractor makes it possible to obtain essential oil, while squeezing the juice, through the application of hot water showers (the temperature of the water is 15 °C), during the extraction to the fruit's peel.

Then, the juice coming from the extractor is driven by gravity to a rotating finisher to reduce the pulp content and even a homogenizer to keep the solids in suspension and that these do not precipitate towards the bottom of the tank.

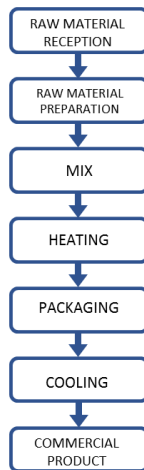
Subsequently the juice goes to the deaerator. This step is of interest because the elimination of air reduces the amount of oxygen available in the product that can produce the oxidation of vitamin C, as well as various other oxidation reactions, which reduce its quality.

The juice from the deaerator goes to the pasteurizer to ensure the microbiological and biochemical stability of the fruit juices. This heat treatment makes use of the steam generated in the boiler and is followed by a cooling step that uses water from a cooling circuit. Finally, the juice is packaged in aseptic packaging.

Finally, in this sector it is remarkable the number of companies that make jellies and jams, and therefore its description is of interest.

The jam is the product prepared by cooking whole fruit or vegetables, chopped, crushed, finished or not, with sugars incorporation until a semi-fluid or thick product is obtained. It has a final minimum sugar concentration of 40 °Brix and a minimum proportion of fruit of 30%.

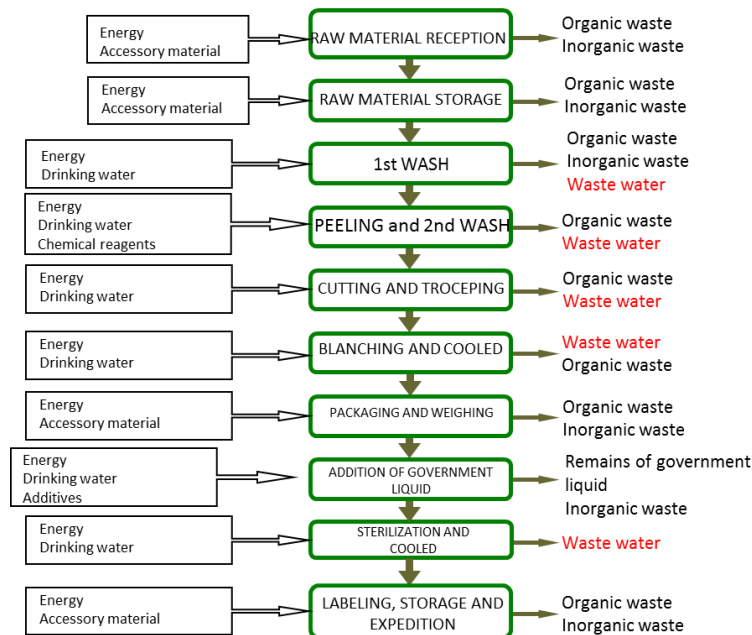
Picture 12 shows the process diagram of jellies and jams elaboration. First step is to produce a pulp from the raw material, fruit, or aseptic pulp can be use. This pulp is crushed, introducing it in a steam double bottom tank, where sugar and citric acid are added in the suitable proportions. In an ultrahigh speed mixing tank, a mixture is formed between sugar and pectin, which is added to the homogenized fruit contained in the tank. The mixed ingredients are cooking for about five minutes, being ready to be dosed in the appropriate containers.



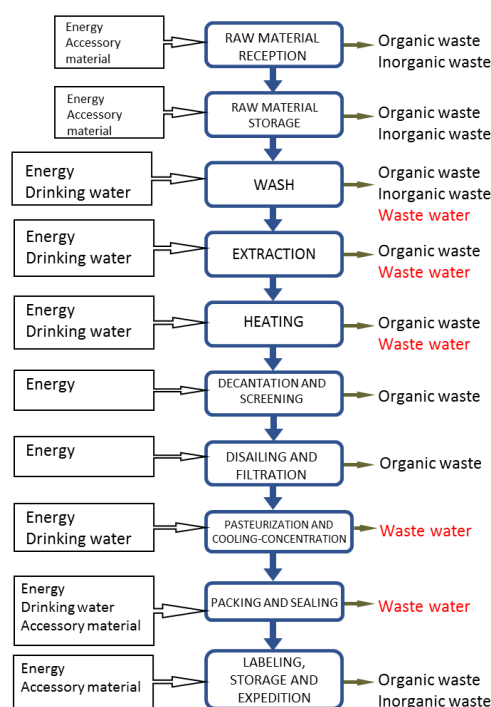
Picture 12.- Jellies and jams Flow chart

A jam can be made from any puree of fruit or seasonal fruit, but strawberry and peach jams are the most commercial.

In general, the elaboration processes of different canned fruits and vegetables such as artichoke, pepper, pear, etc. and juices and nectars, of the Region of Murcia can be described according to the Flow charts of pictures 13 and 14.



Picture 13.- General Flow chart of canned fruit and vegetables



Picture 14.- Flow chart of juices

As it is shown in pictures 13 and 14, the generation of solid waste in the sub-sector of processed fruit and vegetables is important, especially in terms of volume or quantity, the generated waste can be classified in organic, inert and dangerous. The waste most commonly produced in the vegetable processing industry is shown in the following table 1.

Table 1.- Wastes from canned fruit and vegetables industries.

Waste	Code CER	Hazard
Organic waste from fruits and vegetables	020103	No
Paper and paperboard	200101	No
Plastic	200139	No
Cans	200140	No
Glass containers	200102	No
Waste similar to Urban waste	200301	No
Machinery used oil	130203	Yes
Waste from Hazard containers	150110	Yes
sewage sludge	020305	No

Waste figures obtained from the sector indicated that 83% of the waste generated corresponds to organic waste (from cutting, slicing, peeling, etc.). The 16% is formed by inert waste corresponding to cardboard, plastic, glass, tin, etc.

It can be concluded that the main generation of waste from the vegetable processing sector is due to organic waste. Table 2 shows the % generated of plant remains in two subsectors (source BREF Document). Table 3 shows the percentages of waste generated from different raw materials processed.

Table 2.- Sub-sector vegetables waste (BREF May 2003).

Vegetable wastes	
Canned and frozen vegetables	From 1 % (raspberry) to 20 % (carrot, broccoli)
Juices	from 30 to 50 %

Table 3.- Percentages of waste generated from different raw materials processed. Source: CNTA - CTC

Raw material	Waste	%	Raw material	Waste	%
Tomatoe	peel, seed, discard	15	Borage	leaves	28
Piquillo pepper	Heart, peel	53	thistle	Stalk, leaves and heart	65
Morrón Pepper	Heart, peel	50-60	Chard	Stalk, leaves	48
Asparagus	Pieles, trozos	51	Spinach	Dry leaves	13
Artichoke	Bracteas, stalk	60-65	Peach	Peel, bones	22-28
Green bean	ends	28	plum, apricot	Peel and bones	10-25
Mushroom	root, discard	21	Orange, tangerine	peel	40-45
leek	Root, leaves	47	Juice orange	peel	60-65
Garlic	White areas	17	Pear	Peel, seed, heart	42-45
			Apple concentrated	Peel, seed, heart	10-15

The Fresh markets and the transformation of fruits and vegetables, including citrus fruits, generate by-products, which can be valued by the companies themselves or marketed in new markets. Therefore, it is determined that the LIFECITRUS project has defined Murcia's agri-food sector and the possibility of including a new food ingredient with benefits for regional companies.

The agri-food sector has an important regional weight and employs many people and is continuously innovating to meet the needs of consumers in accordance with community guidelines, so that the LIFECITRUS project can be useful for society and the local economy.

5. INITIAL SITUATION OF THE LIFECITRUS PROJECT

At the beginning of the LIFECITRUS project, about 50 companies' fresh citrus fruits had been recorded in the Region of Murcia and approximately 15 citrus processing companies. All of them are potential generators of by-products to be used in the frame of LIFECITRUS project. However,

a huge part of the by-products used come by the AMC partner consortium because the high quantity of by-products that AMC generates.

On the other hand, it can also indicate a number of 10 companies manufacturing jams and jellies located in the Region of Murcia, which are potential consumers of the new ingredient developed within this project. To these companies can be added companies that produces juices and canned fruits and vegetables, because the obtained product can be used as a natural ingredient in the elaboration of other products.

The list of companies has been obtained from information provided by business associations such as:

- Centro Tecnológico Nacional de la Conserva y Alimentación
- Agrupal
- Fecoam
- Proexport
- Ailimpo

And the business databases of the Institute of Development of the Region of Murcia (INFO) and Alimarket.

Picture 15 shows the marketers of fresh and processed products and the list of companies manufacturing jams and jellies in the Region of Murcia.

COMERCIAL FRESCO	TRANSFORMADO	MERMELADAS
AGRIOS EL CARRIL	AGRUMEXPORT	ABELLAN BIOFOODS
ABC	ABC	ALCORNIA ALIMENTACIÓN
ANTONIO PUJANTE	CITRICOS DE MURCIA	COATO
ARCO FRUITS	CITROMIL	COFRUGA
ARTELIMON	COFRUTOS	GRUPO MARIN MONTELIANO
BLANUICA	CREMOFRUIT	HERO
BLANCASOL	DERIVADOS CITRICOS	LA VEGA DEL MAR MENOR
CAMPOTERAR DEL SEGURO	GRUPO MARIN MONTELIANO	SABRIN GIMENEZ
CITRICOS CUELLO	J. GARCIA CARRION	PANARRO FOODS
CITRICOS DEL SURESTE	JUVEN	PRODUCTOS MANIPULADOS ABELLÁN
CITRICOS GONSAPRUTS	MARIN GIMENEZ	
CITRICOS LA PAZ	MIGUEL PARRA E HIJOS	
DIFRUSA EXPORT	PANARRO FOODS	
EL LIMONAR DE SANTOMERA	SILVERBIO ESPAÑA	
EL PICARCHO	ZUMOFRESH LEVANTE	
FRUCA		
FRUGARVA		
FRUTAS ANTONETE		
FRUTAS ARENAR		
FRUTAS BERI		
FRUTAS CONDGO		
FRUTAS GUANTO		
FRUTAS LQAR		
FRUTAS MARGOZ		
FRUTAS NATURALES		
FRUTAS POUEDA		
FRUTAS Y CITRICOS DE ABILA		
GARCIA ARANDA		
GRUPO ROSEGAR		
HACIENDA EL MOLINO		
HIJOS DE ALBERTO DEL CERRO		
HIJOS DE JOAQUIN RODRIGUEZ		
HIPA GROUP SPAIN		
HORTAMIRA		
HORTIBERIA		
LA VEGA DE CIEZA		
LA VEGA DE PLEGGO		
MARIANO SAEZ		
MUNDOSOL		
BARAFRUTS		
SAT SAN CAJETANO		
SCORPIUS FRUITS		
SURESCO		
TANA		
THADER CIEZA		
TOORFRUIT		
URICOL		

Picture 15.- List of companies located in the Region of Murcia related to citrus fruits

In addition, a demonstration project favors the start-up of new processes and therefore the generation of new companies or new industrial lines for the incorporation of workers to companies or improve the quality of their jobs.

This last aspect is due to the training part considered within the LIFECITRUS project, in order to guarantee a greater transfer of knowledge to company technicians, but also to society in general.

Finally, another relevant aspect of the LIFECITRUS project is its objective to obtaining a natural ingredient that allows products to be produced under the organic European legislation, demanded by society and in accordance with the organic certification obtained by 25 of the companies in the Region of Murcia listed in picture 15.

5.1. Base Line

At the beginning of the LIFECITRUS project, there were two companies that made citrus products beyond juices and essential oils: CITROMIL and MARIN GIMENEZ HNOS. The first of these companies produces a very fine puree, which is widely used in fruit and juice preparations (to give them a more natural sensorial characteristics), but also lemon scrape and offer "custom made" products; while the second produces a product called lemon pulp. Both companies have spared their portfolio of products according to the current market demands for jams, pastries, dairy products, ice cream, desserts, etc., just as LIFECITRUS was born (demand for a natural ingredient for the production of clean label food products from food process by-products).

Project Strategy

Summarizing, the implementation of the LIFECITRUS process at the pilot plant of the CTC allows verified the technical viability of it and the possibility to transfer the knowledge to the technicians, workers face to face or through the bulletins available in the web page of the project (www.lifecitrus.eu). In addition, a survey was sent to technicians of agrifood companies and society in general to identify the improvements contributed by the LIFECITRUS project in the Region of Murcia and the development of the LIFE project.

The survey has been filled voluntarily from the project website and in hard copy in the events developed in the framework of the LIFECITRUS project.

Indicators to assess the socioeconomic impact and inconveniences

The lack of Knowledge of the LIFECITRUS process before the project, places the socio-economic impact of the project at a level close to 0, but after the development of the project, this value will modify to positively. To reach this aim, different indicators have been established with the aim to determine the socio-economic impact of the project according to five categories: Generation of new companies; training for employees; employment generation; food promotion with eco-label; and impact on the local economy. These indicators are the number of companies affected, number of jobs, positive opinions on the training of technicians, expenses related to the LIFECITRUS process that will be attributed to the local economy, etc. In addition, the LIFECITRUS process does not require large investments that pose a risk to companies and thus endanger current jobs.

Other social indicators will be defined by the gender and age of the people surveyed, as well as their academic background and employment status, to determine the future projection of the LIFECITRUS process and its possible repercussion in current society, but also future due to the business reaction. And another socioeconomic indicator that is the monthly income of the workers participating in the surveys, in such a way that binding economic information on social categories is obtained.

As main indicators of LIFECITRUS were emphasized those destined to evaluate the training of technicians, since it is committed to an impact in the creation of quality jobs for the promotion of the local economy.

On the other hand, for the valuation of the promotion of the local economy the invoices (diets, diesel, etc.) generated by the project in the Region of Murcia will be taken into account. At the end of the project a value will be added to be compared with the initial situation, which was quantified in a positive value due to the purchase of the equipment "CUTTING AND HOMOGENIZATION SYSTEM WITH HEAD, DRIVER AND INNER" bought to a Regional company: Productos Químicos de Murcia, SA, necessary for the LIFECITRUS process.

Finally, regarding the particular social impact of the actions of the project, LIFECITRUS carried out the analysis of the communication actions to the population of the Region of Murcia. These actions were the total number of people which receive information regarding LIFECITRUS, support to dissemination activities and participation in surveys. The base line was a positive value due to the presentation of the LIFECITRUS project to the media (11 December 2015) and

the disclosure the beginning of the project in the newspaper La Verdad de Murcia (9 February 2016) and TV program “Diario del Campo de 7TV” (March 3, 2016).

The main inconvenience that we can find to carry out the socioeconomic impact study is the lack of information. This fact will be solved using the information provided by survey.

The survey will be an active tool because it is included as an indicator for monitoring the project, and therefore the public collaboration will be evaluated monthly and promotional measures will be taken, if necessary, to guarantee the entry of a large number of surveys and therefore of data.

At the end of the Project, the indicator of the generation of new companies and generation of employment can be zero, because the short duration of the Project that may not be enough to promote investments necessary in the companies of the Region of Murcia. The success of these two indicators will be enough with a positive intention indicated in the survey.

At national level, there is a lack of interest in the development of food with an organic label, but the high number of companies located in the Region of Murcia certified in Organic Agriculture supports the achievement of the objective for organic development.

Finally, the use of by-products, in the production of new foods, could have a negative aspect for the consumer, but a positive interest from society will be arise by promoting an improvement of the current environmental situation by providing economic value to a waste.

6. RESULTS OF THE SOCIO-ECONOMIC IMPACT ANALYSIS

6.1. Background

The information regarding initial situation was obtained through the surveys carried out "in situ" in dissemination sessions or through the web page. The target population has been employees of food companies in the Region of Murcia, students in the subjects of food technology and chemical engineering, farmers and scientific researchers. Furthermore, through reports and interviews in the media, dissemination to the general population, etc., with the aim to reach society in general in the Region of Murcia.

A summary of activities developed within the LIFECITRUS project at the regional level has been:

- Initial presentation of the project within the framework of the General Assembly of Canned industries 2015 (December 2015)
- Attendance to a meeting with companies on Import and Export Management (February 2016)
- Recording a video at the demonstration plant in CTC (February 2016)
- Start-up of a web page with updated news (February 2016)
- Interview for article in local newspaper (March 2016)
- Dissemination by advertising posters at the partner offices (April 2016)
- Guided tour in the demonstration plant at CTC of journalists and business technicians (November 2016)
- Development of an advertising video of the project (February 2017)
- Participation in the VIII Symposium on Food Technologies and the Event Food Brokerage Event Murcia 2017 (May 2017)
- Participation in the Week of Science of Murcia (November 2017)
- Interview on the local television Curiosity Section (December 2017 and April 2018)
- Meeting at the General Assembly of Cannery 2017 (December 2017)
- Guided visit to the demonstration plant for journalists and directors of regional public bodies (January 2018)
- Dissemination in the 9th International Chemistry Congress of the ANQUE (in June 2018)
- Attendance in different seminars / courses held at the facilities of the University of Murcia, Polytechnic University of Cartagena and San Antonio Catholic University, all sited in Murcia.
- Development of brochures, newsletters, articles in technical magazines, news on social networks.
- Dissemination and meetings with companies.
- Guided visits for students and technicians of companies to the demonstration plant.

Summarizing, more than 5000 people from the Region of Murcia had accessed project information through all the dissemination actions carried out, contact with companies, training courses and web page. These figures are greater if it is included the transfer of information to society in general, the internal communication of colleagues within companies, families and friends. More than 500 people have visited the demonstration plant located in CTC, Molina de Segura.

Finally, the surveys were completed by 100 people, but not all questions were answered due that the surveyed considered that some questions were against their industrial confidentiality policy.

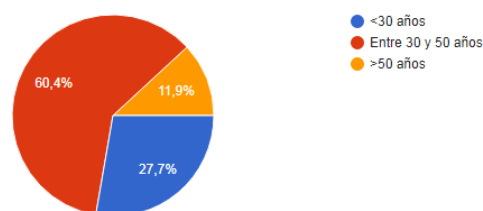
The collaboration to fill out these surveys has been due to the knowledge of the LIFECITRUS project through the project partners and their web pages, the project website, social partners' networks, press, Conference organization and organization of Training Courses.

The surveys were received from the beginning of 2016 until the middle of 2018. During this period, more than 24 months, it has been possible to evaluate the most recent situation in the Region of Murcia at a social and economic level, as well as the agri-food sector, and have a brief knowledge from the implementation of LIFECITRUS process at regional level.

6.2. Description of the surveyed

Of the 100 surveys filled, 58 were conducted by men and 42 were by women. The 76% of them were from the center of Murcia; 14% was distributed in different municipalities such as Moratalla, San Javier, Alcantarilla, Molina de Segura, Librilla, Cartagena and Calasparra; and the remaining 8% other neighbour areas such as Pilar de la Horadada, Orihuela, Elche, Alicante, Almeria and Granada. Finally, two people have filled the survey from Boston (USA) and from Santiago de Querétaro (Mexico).

Picture 16 indicates that the ages of the surveyed, more than the 50% were between 30 and 50 years old, the age of the largest active population in the Region of Murcia. The responses from people under 30s are students who wanted to know about the LIFECITRUS project at the National Technological Center for canned and Food.



Picture 16.- The surveyed ages

On the other hand, the people who have carried out the surveys have been technicians who indicated a University studies (73%), which indicates a greater participation of people with a high academic level compared to 5% of people with minimal or no education. These data may

be due to the low access of the general population to technical information from web pages. In addition, the disclosure of the project through interviews and reports in the media, and events framed for the public (Science Week of Murcia), has not guaranteed access to the LIFECITRUS project by the general population.

The 75% of the surveyed work as employees in the food and R&D sector. Not all have indicated a sub-sector but are involved within the sub-sector of citrus fruits, canned food, infant feeding and organic certification. And they mainly develop final or semi-finished products within Murcia's agri-food sector.

Regarding the income of the surveyed more than a half receive a salary between 1200 and 2000 euros per month. The remaining surveyed are below 1000 euros. This figure indicate that the surveys were filled by technical employees of companies, but not by managers.

Environmental awareness was valued through a series of questions related to their knowledge of environmental financing programs, aspects of sustainability in companies, interest in environmental training, etc.

The 80% of the surveyed knew the LIFE programme of the European Union and they consider that it is interesting to implement environmental processes in companies. Among the comments provided by the respondents we can highlight the following:

"In spite of not having too much knowledge about all the companies involved in this project, I think that these companies have an important position within the food sector in their geographical area/country, therefore, they have the capacity to develop interesting projects and also feasible and convenient realities for the environment".

This comment could summarize the current opinion of company technicians on the success of these projects, because the involvement of smaller companies does not guarantee high replicability because of their lower resources and budget for new investments.

On the other hand, for the evaluation of business sustainability, a list of items was proposed that included the concepts such as Energy efficiency, Water saving, Waste valorization, Use of natural ingredients, Substitution of critical or dangerous substances, etc. It can emphasize that Energy Efficiency and Water Saving are the topics that most concern the surveyed. These results could be due to the high costs of the electricity and to the problem in the Region of Murcia about the scarcity of water resources. The recovery of waste is the third most considered aspect and the

majority of the surveyed (98%) agree that the recovery of by-products can be interesting. The recovery of waste is the third most considered aspect and the majority of the surveyed (98%) agree that the recovery of by-products can be interesting. In addition, they have indicated that their companies use discarded materials for other industries such as animal feed and as a biomass. The surveyed believe that companies improve their productivity, but also the image of the company (due it is included in the industries environmental policies).

Also, the surveyed pointed themselves with a high score, between 4 and 5 out of 5, in relation to their attitude as consumers of products from companies that have a greater involvement with the environment, but only the 9% indicated that attended to training environment courses and the 56% attended occasionally. These figures show that the technicians and people who develop their activity within the agri-food sector and R&D are aware as consumers, but their work routine does not include continuous training in environmental issues.

Finally, the skills of the surveyed as a consumer was evaluated to determinate the repercussion of the new natural ingredient developed in the framework of the LIFECITRUS Project. The conclusions were:

- The 82% of surveyed believe that the LIFECITRUS project is adequate to the current needs of food companies.
- About 89% of the surveyed answered the question "As a consumer, do you read the label of the products that you consume?" The answers were YES and most of them indicated that they know all the indicated ingredients.
- The 85% prefer products made with all-natural ingredients.

It can be concluded that the surveyed showed a profile of a well-trained and aware consumer with a healthy diet.

6.3. Impact of the LIFECITRUS process on employment and training

According to the answered of the surveyed that has collaborated in the survey to the questions "Do you consider interesting the training for technicians of a food company regarding the LIFECITRUS process?", "Would you be interested in visiting the pilot plant of the LIFECITRUS project to learn more about the LIFECITRUS process?" and "Would you be interested in visiting the pilot plant of the LIFECITRUS project to test the application of the new ingredient in a food

product?" It can be concluded that technicians and students would be interested in receiving training on the LIFECITRUS process and use the demonstration plant.

The 64% of surveyed believe that the incorporation of new employees to the companies will need LIFECITRUS training course. They consider their personnel trained or suppose that they would train it internally. However, the 69% of the surveyed would require a university degree training, and the 54% vocational training, for the tasks to be carried out the LIFECITRUS process, which may imply an improvement in employment within the companies of the sector by expanding training of its workers.

The evaluation of the current social situation of the Region of Murcia and its employment figures, according to the Labor Market Report of the province of Murcia 2016 data made by the Public Employment Service of the State in the year 2017, determined that specialized hiring is not significant in the worker market of the Region of Murcia, the LIFECITRUS Project emphasis on the possibility of hiring university graduates in the regional agri-food sector. In addition, hiring would preferably be focus for unemployed according to the results of the survey, 88%, in addition to residence in an area close to the company.

Therefore, the perspectives after LIFECITRUS project for the worker market have an interesting on the agrifood sector of product transformation and endorse the promotion of local employment for the development of the area where the companies are located. Finally, it is noteworthy that they would consider that the local economy would be benefited.

6.4. Impact of the LIFECITRUS process on the economy. Implementation cost.

The 82% of the surveyed indicated that it would be interesting to create a company based on the results of the LIFECITRUS project, but there is no agreed economic assessment of the investment needs and associated costs in their implementation. In some cases, the surveyed has indicated the need for a feasibility plan, but the rest prefer to invest a fixed cost. The investment margin is variable and very broad because there are figures from 0 euros to 1.5 million euros. This response is considered subjective for technicians and collaborating students because, in any case, they do support that companies should invest in the implementation of the LIFECITRUS process, but not them in particular.

On the other hand, the LIFECITRUS process has validated a new machinery capable of producing a product with puree appearance from the treatment of by-products that are discarded from

the citrus processing industries or from lower-quality raw materials from the farmers themselves. This machinery can expand the food companies' applications and the machinery manufacturers increase their sales, improving the economic impact that this implies in the sales of products through marketers in the Region of Murcia, which also have economic benefit.

In addition, the commercialization of the rest of the equipment of the LIFECITRUS process allows to improve the local economy. In fact, the sector of food machinery is a leading sector in the Region of Murcia. The manufacturers of machinery for the agri-food industry of the Region of Murcia have extensive experience based mainly on their proximity to the important regional manufacturers of canned vegetables and juices; and also a technical capacity that allows them to design, build and implement advanced equipment and complete processing and packaging lines. In this context, Murcia manufacturers of agri-food machinery have a high technological potential and the development of new products and markets based on their skills, experience and knowledge, which would allow them to advance by developing products demanded by regional companies that would like to implement the LIFECITRUS process.

The development of the economy depends on the business evolution and, therefore, the creation of new companies capable of supplying products of interest for the current market or opening new markets. Next, the necessary cost is indicated for the implementation of the LIFECITRUS process on an industrial scale. This cost was presented to the surveyed in order to support the LIFECITRUS process economic viability.

Implementation costs of the LIFECITRUS process

Therefore, we have taken as a reference the location of a citrus peel processing line in an example industry of the Region of Murcia, but more specifically in the city of Murcia for presenting foci of generation of the byproduct in its surroundings.

Investment and maintenance costs

The line has been designed to process and pack lemon rind and consists of the following sections:

- Line of reception and processing of product
 - Washing the peel
 - Reduced size

- Inspection of the product through artificial vision
 - Centrifugal separation by decanter
 - Reduced size (microcutter)
 - Cooking
- Sterilization and packaging
- Aseptic filler

The capacity of the designed line has been selected according to a production of 6 tons / hour, since it has been considered an example citrus juice industry that works 3,600 hours / year and that can generate about 20,000 tons per year of by-products.

The budget received is 1,340,000 € for the total of the necessary equipment and will be an investment contributed by an example company of the sector of elaboration of citrus juices (Table 4).

Table 4.- Equipment required to obtain citrus puree in the proposed installation

	COST (€)
Washing	55,000
Cutter	115,000
Inspection (artificial vision)	225,000
Centrifugal separation by decanter	150,000
Reduction of size	65,000
Cooking	125,000
Sterilization	375,000
Aseptic filling machine	230,000
Initial investment	1,340,000

The life of the equipment has been considered for 7 years under normal operating conditions with adequate maintenance. Thus, the annual amortization is intended to be 191,428.57 €/year.

On the other hand, the annual cost of maintenance and operation has been considered 6% of the initial investment.

No costs for land, civil works or similar have been taken into account. This study focuses on the installation of a production line in an existing company and that has the necessary means for the implementation of this process.

Personal costs

Because the citrus peel processing line has been planned for an existing industry, the need for a high number of workers is not anticipated. It is considered that 3 operators are enough to control the process.

The hour-person cost is € 12, carrying a work shift of 8 hours a day.

Production costs

In the processing of the citrus peel requires water for the washing stages, as well as consumption of electricity and energy for the operation of the equipment.

On the one hand, water consumption has been established at approximately 20 m³/tonne processed due to the washing and cleaning stages of the equipment. The cost of m³ of drinking water in the city of Murcia has been taken with a value of 1.36 €/m³.

On the other hand, the discharges produced in the processing line have to be treated in a wastewater treatment plant. According to previous studies carried out by the CTC, the cost of treatment of waste water treatment can be in the average value of 2.4 €/m³, considering a biological treatment of waste water.

The industrial waters produced by the agrofood industry contain contaminants that in many cases exceed the parameters established by the legislation. They usually have high organic loads, which is characterized by their high levels of Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD). This problem causes the need to reduce levels of pollutant load, in order to comply with the parameters imposed by the legislation. In particular, it has been demonstrated that biological treatment is required because of the characteristics of these waste waters. This type of treatment is already implemented in industries such as the example considered.

As for the rest of consumption, according to the line designed, the electrical consumption of the equipment used has been estimated at 175 kWh for the whole line, with a unit cost of 0.12 €/kWh.

The energy cost is due to the consumption of natural gas to obtain steam. It has been estimated that the equivalent consumption of kWh will be 2,300 kWh in a boiler of 6,000 kg of steam. The unit cost considered is 0.042 €/kWh.

Packing costs:

The citrus peel, for its use, should be transformed into a non-perishable product, packaged in industrial containers such as aseptic bags, widely used today for pulps, concentrates and fruit purees.

Because the process efficiency has been estimated at approximately 60%, the output flow required to be packed is 3.6 tonnes/hour. For this purpose, metal containers of 200 kg capacity and aseptic single barrier bags will be used. It requires a total of about 65,000 containers per year, with a unit cost of 11.7 €/container.

According to the data previously discussed, the total cost associated with the citrus peel processing line is 3,139,678.6 €/year (Table 5). The calculation of the unit cost has been determined for an estimated production of 12,960 tonnes per year.

Table 5.- Annual cost LIFECITRUS process

Type of cost	Annual cost (€/year)	Unit cost (€/tonne product)
Amortization (7 years)	191,428.57	14.77
Maintenance and operation employees	80,400	6.20
Production	51,840	4.00
	2,057,850	158.78
Water consumption	587,520	45.33
Waste water	1,036,800	80.00
Electric consumption	75,600	5.83
Energy consumption	357,930	27.62
Packing	758,160	58.5
TOTAL	3,139,678.57	242.26

6.5. Impact of the LIFECITRUS process on the promotion of organic products. Circular economy

The surveyed indicated that the local economy will be favored with the development of the actions of the LIFECITRUS project and that it will be due to the development of products classified as organic. However, At the end of the project it has been possible to conclude that LIFECITRUS project was not able to achieve a strong boost of organic products, and so, it is proposed the support of governmental and nongovernmental associations that promote a Murcia Organic brand because the Region is the leader at the national level in the matter of organic agriculture, regarding to the grow area, which supposes a great socioeconomic and environmental development.

In addition, the Council of Organic Agriculture of the Region of Murcia, dependent on the Autonomous Community, whose contact had initially been considered for its link with organic

production, is currently a high workload due to the numerous records made by the Murcia farmers for their organic certification and has not been able to collaborate in the LIFECITRUS project.

It is noteworthy that organic farming considers traditional agricultural knowledge and they have a deep knowledge in techniques to continue improving in all aspects and presents quality products that consumers demand. Therefore, the commitment to organic products must be strongly supported and the LIFECITRUS project has dedicated part of its activities to making itself known to companies such as GranBiBio Supermarkets, based in the Region of Murcia and which has opened a market near the consumer with organic products.

GranBiBio encourages the consumption of products that are cultivated following the cycles of nature, respecting the rhythm of growth of plants and animals, thus avoiding intensive and forced production, improving the quality of the food. In addition, he works with local fruit and vegetable farmers, guaranteeing freshness and closeness in the distribution, while contributing to their economic development. On the other hand, it sells products from operators with organic certification to which, in turn, it submits to an internal control of additional quality.

According to the Council of Organic Agriculture of the Region of Murcia, there are more than 30 specialized stores for organic food and web pages in which many consumers buy. This offer is due to the high demand of organic food, but prices are high due logistics cost.

Also data from the Council of Agriculture indicate that one in every four hectares of crops in the Region of Murcia is organic and these data will rise over the years because awareness is slight increasing. In Spain, the average consumption of organic products is less than half per citizen per year compared to countries such as Germany, Sweden and Switzerland.

In 2016 the First Campaign for Promotion and Dissemination of Organic Products of the Region of Murcia was organized by the leading companies in the sector and the Council of Organic Agriculture of the Region of Murcia with the support of the Ministry of Agriculture. This campaign has managed to put information leaflets into the society to create regional interest, but more measures are needed to boost the presence of organic products in general and some of them could be the basis of education, with the development of school gardens in schools and institutes and speeches focused on these products and the commitment to the circular economy. This circular concept would make it possible to add the efficient use of resources to

regional production, where the reduction, reuse and recycling of the elements are prioritized, in accordance with traditional (organic) sustainable production practices.

We do not want to miss the opportunity to deepen the circular economy, the transition to an economy harmonious with nature is urgent in the face of the seriousness of current environmental problems: the end of the era of fossil fuels, the shortage of materials, land and water, climate change, loss of biodiversity, etc. In addition, by reducing production costs, the price of the products and the consumers saves and contributes to the care of the natural environment.

Therefore, the Circular Economy could be a great engine for the generation of jobs around the world and its economic development through competitive advantages in the global context, which would result in lower production costs and the achievement of more demanded organic products, all in line with the objective of environmental sustainability that has been proposed from the European Commission, for European countries, where the Region of Murcia is located.

7. SOCIO-ECONOMIC IMPACT IN THE REGION OF MURCIA DUE TO THE PROPOSED AND ORGANIZED TASKS FOR THE LIFECITRUS PROJECT

The LIFECITRUS project initially planned a series of tasks and their associated costs for the correct development of the project and its dissemination in the business sector and the public in the Region of Murcia. These data are collected in table 6.

Table 6.- Project costs invested in the Region of Murcia.

	Coste (€)
Meetings with personnel interested in the project in the Murcia area and general dissemination. Fuel and food	1300
Purchase of new equipment to Murcia company. High speed cutter	67000
Purchase of consumables and external services	31300
Contracts to companies specialized in diffusion, organization of events, specific technical reports, web development, etc..	90000
Personal salary of partner companies of the Murcia project	466270
Total	655,870

The total budget of the project was 886,397 euros, so about 75% of it has been used in the economy of the Region of Murcia. The European Commission, through the LIFE program of financing environmental projects, has contributed capital to the Region of Murcia by supporting

the project "Recycling of citrus industry by-products for the development of a new natural ingredient" and has succeeded in to know the project to more than 5000 people of the Region through the different dissemination actions and through interviews in the local media. In this aspect it can be highlight the two reports broadcast on the "Diario del Campo" program of channel 7 Television Region of Murcia and the interviews also broadcast by 7 Television Region of Murcia in the Curiosity section of the morning news; as well as the news broadcasts on the radio station Onda Regional and RTVE Noticias Murcia.

Therefore, at a social and economic level, the expenses related to the dissemination have been enough to make the LIFECITRUS project known to the society of Murcia. The partners of the Project will continue working on the enhancement of the valorization of the by-products citrus (especially lemon), with a high production in the Region of Murcia, to ensure that in the coming years, not only large companies, but also companies with fewer economic resources decide to invest in more sustainable processes, by the project LIFECITRUS as a local success case that can be extrapolated to other citrus production areas and their processed ones.

8. BENEFITS OF THE PREPARATION OF A NEW INGREDIENT (PECTIN SOURCE PRODUCT). LOCAL INTEREST

Pectins are the main gelling agent used to restore certain texture degraded by conservation treatments and to allow their presentation in a form appropriate to their good maintenance and use (they have the unique property of forming gels extendable in the presence of sugar and acid, and in the presence of calcium ions).

The commercial pectin is obtained from fruit waste, particularly waste and by-products from the production of juices (apple and citrus). These raw materials are used because they produce high quality pectin, contain large amounts (about 25% pectic substances) and are available in enough quantities to be commercially viable. In any case, citrus by-products are mostly used. Specifically, companies engaged in the industrialization of citrus fruits to produce juices or other products, generate a percentage of waste near 50% of the weight of the original whole fruit in the form of bark (consisting mainly of albedo and flavedo), seeds, membranes and skins from the juice vesicles, which can be used.

When we speak of citrus, we refer to the genus *citrus*, which contains three species and numerous cultivated hybrids, including the most widely marketed fruits, such as lemon, orange, lime, grapefruit and mandarin, with various varieties depending on the region where each of them is cultivated.

On the other hand, pectin is found in fruits under an insoluble form known as protopectin, which is easily converted into the soluble form by gentle hydrolysis. This pectin solution can be precipitated with alcohol, then washed and dried, obtaining pectic acids (pectins). In summary, the commercial pectin extraction method is a traditional technique of extraction with acids and precipitation with alcohol, where the raw material must be conditioned to improve the extraction reducing its size.

With the indicated process, acid hydrolysis, it is possible to obtain pectin that meets the market requirements, that is: percentage of methoxyls, degree of gelation, equivalent weight and percentage of galacturonic acid. The process has a good economic performance, which makes it an alternative for the by-products of the production of citrus juices.

In any case, this method generates a series of environmental problems that has resulted in high costs of wastewater treatment, and closure of factories in countries such as the USA.

An important challenge for the food industry is to achieve natural resources to develop high added value foods using environmentally friendly techniques. The proposal of the LIFECITRUS project is to obtain a citrus concentrate with puree appearance, where extraction techniques that require the use of chemical reagents are not used. In addition, the process uses technologies known by the vegetable processing sector, for easy implementation. And to this is added the energy cost savings of the drying stage.

It cannot be forgotten that the final characteristics of the pectin depend on the vegetable or fruit from which it is being extracted and the conditions of this, as well as the methods used for the extraction and transformation.

On the other hand, the selling price of the commercial pectin used is approximately 12.5 €/kg, but due to the results obtained in the evaluation of the jams it can be said that the citrus puree used corresponds to a pectin concentration of only 4%. The selling price of the puree has to be adjusted to the percentage it contains, since a greater amount of puree is required to obtain the

same result in a product that uses commercial pectin powder. Considering a 4% pectin content, the selling price of the citrus puree could be 0.5 €/kg.

Finally, the puree of citrus is a natural ingredient that can be incorporated in the elaboration of different food products avoiding the use of chemical additives. The use of this product as a substitute for pectin used so far gives the product a completely natural character and releases it from the use of preservatives "E" in the product.

In the Region of Murcia there is a tradition of companies that are engaged in the manufacture and marketing of jellies and jams, highlighting the company Hero España, based in Alcantarilla and which has been developing its industrial activity since 1922, currently being a benchmark in the food industry. In 2016, its turnover exceeded 176 million euros and is ranked among the first 15 regional companies in the 2017 Ranking published by Murciaeconomía.

Its business strength shows that it has been able to adapt to changes and market needs. It has gone from being a company of canned and traditional food to an advanced nutrition company, oriented to innovation applying criteria of sustainability in all its productive processes. Every day it works to offer the best products to its consumers through the incorporation of environmental criteria and the conservation of natural resources, minimizing the environmental impact produced by its activity.

It has also been remarkable the contact with the companies COFRUSA, Marin Montejano (Mocitos) and Alcurnia Alimentación, SL, located in position 108, 143 and 160 respectively of the 2017 ranking of regional companies, which are also engaged in the preparation and marketing of jams and jams.

These companies present an environmental commitment as they try to minimize their polluting footprint and opt for the Sustainable Development of the Region of Murcia. The certification through the ISO 14001: 2015 standard endorses its commitment to environmental management, as well as work with raw materials with organic certification.

8.1. Interest in the new ingredient

The puree obtained has been tested as a substitute for pectin in the production of jams. The procedure consisted in the formulation of different strawberry jams with citrus puree in the recipe, which were compared with a commercial jam (which in its recipe included pectin commercial powder). Subsequently the consistency and sensory results were evaluated. It is

noteworthy that the difference between the two required a different amount of cooking water. In particular, the recipe with citrus puree required less water to cook the strawberry.

The contacted companies have been able to know the new ingredient in the different demonstration actions that have been organized, but the real interest has not been very broad because the comments obtained after conversations held do not support a quick interest for industrial implementation in these companies. The companies are not susceptible to carry out a new market product that is not yet industrially produced. They might be interested in their use, but as long as the companies can check their application in their particular products and the supply is continuous, with affordable costs and present a non-variable characterization, as it is up to now the commercial powder pectin supply.

The commercial pectin is a product that can be easily stored taking up little space, but the new proposed ingredient has moisture and occupies a larger volume.

Therefore, Jams and jellies companies show interest in opening a new market line, which would enter as consumers, to offer their customers more environmentally sustainable products with healthier properties, but you should not assume an increase of costs without social repercussion because then the economic benefits, that we cannot forget that they are objective of the companies, would not exist and could not maintain the productivity and therefore employment and development of the Region of Murcia.

9. CONCLUSIONS

In this socioeconomic study, the main conclusions are:

- The Circular Economy could be a great engine for the generation of jobs around the world and its economic development through competitive advantages in the global context, which would result in lower production costs and the achievement of more demanded organic products.
- The European Commission, through the LIFE program of financing environmental projects, has contributed capital to the Region of Murcia by supporting the project "Recycling of citrus industry by-products for the development of a new natural ingredient" and has succeeded in to know the project to more than 5000 people of the

Region through the different dissemination actions and through interviews in the local media.

- A survey was sent to technicians of agrifood companies and society in general to identify the improvements contributed by the LIFECITRUS project in the Region of Murcia and the development of the LIFE project. The surveys were completed by 100 people and it is remarkable that the surveys were filled by technical employees of companies, but not by managers. Environmental awareness was valued through a series of questions related to their knowledge of environmental financing programs, aspects of sustainability in companies, interest in environmental training, etc. Most people of the surveyed knew the LIFE programme of the European Union and they consider that it is interesting to implement environmental processes in companies. Among the comments provided by the respondents we can highlight the following:

"In spite of not having too much knowledge about all the companies involved in this project, I think that these companies have an important position within the food sector in their geographical area/country, therefore, they have the capacity to develop interesting projects and also feasible and convenient realities for the environment".

- The surveyed, as consumer, showed a profile of a well-trained and aware consumer with a healthy diet and indicated that prefer products made with all-natural ingredients. And as developer indicated that he/she would be interesting to create a company based on the results of the LIFECITRUS project, but there is no agreed economic assessment of the investment needs and associated costs in their implementation.
- The proposal of the LIFECITRUS project is to obtain a citrus concentrate with puree appearance, where extraction techniques that require the use of chemical reagents are not used. In addition, the process uses technologies known by the vegetable processing sector, for easy implementation.
- The puree obtained has been tested as a substitute for pectin in the production of jams. In the Region of Murcia there is a tradition of companies that are engaged in the manufacture and marketing of jellies and jams. These companies might be interested in their use, but as long as the companies can check their application in their particular products and the supply is continuous, with affordable costs and present a non-variable characterization, as it is up to now the commercial powder pectin supply. In addition to selling price of the puree has to be adjusted to the pectin percentage it contains because

a greater amount of puree is required to obtain the same result in a product that uses commercial pectin powder.

- The use of this product as a substitute for pectin used so far gives the product a completely natural character and releases it from the use of preservatives "E" in the product.