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Digitisation in agriculture as a factor of competitiveness¹

1. Introduction

When studying a country's economy, a key factor is the understanding of the sectoral structure of that economy; that is, the significance of each productive sector within that economy. The productive sectors of the economic activity of a given territory are distinguished according to common characteristics. Traditionally a distinction has been made between: “primary sector” (obtaining resources directly from nature – this would include agricultural and fishing sectors), “secondary sector” (transformation of raw materials into final products and semi-finished products – this includes industry, construction and the energy sector) and “tertiary sector” (grouping together those activities that offer services to consumers and encompassing very diverse activities: commerce, tourism, health, education, transport, etc.).

Drawing our focus to the specific area of agriculture and its economic activity (and the purpose of this study), it is necessary to note that among the three productive sectors mentioned, the primary sector does not add value

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¹ This study is part of the investigation team Ciberseguridad en la producción agroalimentaria. Qué protocolos jurídicos de actuación, VA049G18, de la convocatoria de subvenciones destinadas al apoyo de los grupos de investigación reconocidos de universidades públicas de Castilla y León, BOCYL 4 de junio de 2018, IP: E. Muñiz Espada.

to the product beyond its intrinsic natural worth. However more recently, extractive mining activities (without transformation of the mineral) have been excluded from this sector and included in the secondary sector.²

The primary sector comprises the following subsectors: the fishing sector on the one hand and the agricultural sector on the other³ – the components of which include farming, livestock, forestry and hunting. Agriculture covers all those economic activities regarding the cultivation of land, breeding of livestock and use of forest resources. The former (cultivation of land) represents the greater proportion of the agricultural sector with just over 55%, followed by livestock activities, with just over 40%, and at on a considerably lesser scale forestry, with a percentage that barely reaches 4%.⁴

Having considered what is understood as the agricultural sector and the composition of this production sector, in the following sections of this paper we will proceed to examine the weight of agricultural activity in the Spanish national economy as a whole. We hope to highlight how this a sector that, despite its progressive decline, affects us all and every day more significantly, as the period affected by the Covid-19 pandemic has shown. The competitiveness of this market depends on an awareness of the need for constant updating and modernisation of the agricultural sector. This requires the use of new information technologies and data processing as the main source of profitability.

2. Agricultural production factors

When analysing the current structure of the agricultural sector in Spain, it is necessary to study three basic factors involved in its production: land, labour and capital.

² In recent years this conventional division of the economy has been complicated by the addition of other new sectors to this classification: the quaternary sector (certain services related to information and knowledge) and the quinary sector (activities related to education, health, culture, etc.). This “complication” therefore derives from the subdivision of the classic tertiary sector or service sector into several different sectors.

³ This productive sector has been the object of interest on the part of economic doctrine since its origins, from Adam Smith, Ricardo or Malthus to the present day, and this is because practically all schools of economic thought have analysed the contributions of the agricultural sector to economic development.

⁴ It is striking how little this subsector contributes to the agricultural sector and to the national economy as a whole, especially as just over half of Spain’s surface area is forest (some 20 million hectares). However, it is fair to acknowledge that its importance has grown in recent years thanks to better exploitation of the resources provided by our forests.

2.1. Land

The total surface area of our country is 50.6 million hectares. Of this surface, more than 19 million are forest land, just above 17 million hectares are agricultural land (meaning that almost 34% of the total national surface area is arable land), over 8 million hectares are dedicated to meadows and pastures, and the remaining 6 million hectares are made up of other types of land area (for population, industrial use, roads, railways, rivers, lakes, etc.). Of the total arable land, over half of this land (some 9 million hectares) is devoted to arable crops, 5.1 million hectares are devoted to woody crops and thirdly, 2.7 million hectares are fallow.

In the case of Spain's arable land, the large area devoted to cereal cultivation is considerable with more than 6.1 million hectares (more or less 37% of the total cultivated area). Of the variety of cereal, the surface destined to production of barley stands out with almost 3 million hectares. Wheat is grown in over 2 million hectares, oats in almost 400 thousand hectares, corn around 359 thousand hectares, and rye with an extension of cultivation close to 150 thousand hectares. Arable crops are followed by the land dedicated to woody crops with more than 5.2 million hectares. To highlight would be the olive grove, which consists of around 2.6 million hectares, and vineyards with almost 1 million hectares. Finally to consider is fallow land, with more than 2.8 million hectares.

Therefore of the total 17 million hectares of cultivable surface in Spain, over 9 million are destined to the cultivation of cereal, olives and grapes. That is to say, over 50% of all cultivation land is dedicated to the production of these types of plants. Given the significant economic consequences, we will now analyse the distribution of arable land between dry and irrigated land, as the estimated yields of irrigated land are five times higher than those of dry land.

Of total arable land, almost 80% of the area is rain-fed (about 13 million hectares) and just over 20% is irrigated (almost 4 million hectares). Therefore, when analysing the systems of land exploitation, we see that the weighting of irrigation in our country is much lower than that of dry farming. However, if we examine the evolution of this distribution in recent decades, we can see how there has been a determined commitment on the part of farmers in favour of irrigation and the modernisation of agricultural exploitations.⁵

Another issue of interest when studying the land factor is that of price per hectare of arable land. Here, the first thing we must point out is that

⁵ It is worth noting that a century ago, in 1920, the number of irrigated hectares was 1.35 million, which has almost tripled.

the average value of a hectare in recent decades has increased considerably, basically since 1998 with the application of the common agricultural policy (CAP), when this policy established economic rights linked to land. However, this is not the only explanatory factor for this increase as one could also consider the real estate “boom” and the demand for land on which to build, the promotion of new renewable energies, such as solar (with the proliferation in our fields of “solar gardens”) and wind (wind farms in our territory), etc.

According to data provided by the Ministry of Agriculture, Fisheries and Food, the average price of land for agricultural use increased by 3.3% in 2018 compared to 2016, rising from 9,882 euros per hectare in 2016 to 10,209 in 2018.⁶

When examining the average price per hectare according to the type of land, we naturally observe a large difference between the value per hectare of land dedicated to irrigated and non-irrigated crops. While in the first case, the price per hectare of irrigated land exceeds 28 thousand euros, in the case of non-irrigated crops prices barely exceed one third of that figure, reaching 9,447 euros per hectare in 2018.⁷

To conclude the study of the land factor within the Spanish agricultural sector, we will examine the number of farms (agricultural holdings),⁸ their size, and the ownership regime. According to the latest data published by the National Institute of Statistics (INE)⁹ and corresponding to 2016, the number of farms stood at around 945 thousand which represents a reduction of 2.1% compared to 2013. This year the number of farms was approximately 965 thousand. If, along with previous values we take into account that in the same time period (2013–2016) the Used Agricultural Area (UAA)¹⁰ was reduced by 0.3%, this results in an increase of 1.6% in the average UAA per farm, from 24.7 hectares in 2013 to 25.1 in 2016. The traditional existence in the Spanish case of agricultural exploitations with a very reduced size questions its very economic rationality, since this small-scale farming considerably limits the use of modern machinery,

⁶ Data collected in the Land Price Survey 2018, published by the Ministry of Agriculture, Fisheries and Food in 2019.

⁷ *Ibidem*.

⁸ By agricultural holding we mean the economic unit from which agricultural products are obtained under the responsibility of a single holder.

⁹ *Encuesta sobre la estructura de las explotaciones agrícolas (EEA). Año 2016*, Instituto Nacional de Estadística, Madrid 2017.

¹⁰ According to the INE, the UAA is the total area of cultivated land and land for permanent pasture.

makes pest control difficult, and in many cases prevents the irrigation of these plots among other issues.

However, this problem has been corrected in recent decades thanks to the process of land consolidation (a procedure promoted by public authorities and whose main objective is to make pre-existing farms profitable by grouping together several smallholdings belonging to different owners) and thanks to the land tenure system, since certain farmers have operated not only on their own plots but also on others through leases or sharecropping contracts. If we analyze the agricultural area used according to the land tenure regime, one of the main conclusions is that almost 10 million hectares are not exploited directly by their owners, but by tenants and sharecroppers. This fact does also carry with it important economic consequences, since it discourages the improvement of these plots by non-owners.

2.2. Labour¹¹

With regard to the labour production factor, the active population in the agricultural sector accounted for 4.2% of the working population in Spain in the fourth quarter of 2019 and signifying just under a million individuals, having recovered somewhat in comparison to data prior to the economic crisis of 2008. However, if we analyse this evolution over a longer period, the fundamental observation is a lesser significance in this sector. Since the beginning of this century, the active population in this sector over the total active population has fallen by more than two percentage points, and more than 35 percentage points if we compare it with data from 1960. We must not forget that one of the main economic consequences of economic development is the transfer of the active population from the agricultural sector to the secondary, and then on to the tertiary sectors.¹²

With regard to the employed population and according to data from the fourth quarter of 2019, almost 800,000 people were employed in the national agricultural sector, representing 4% of the total employed population in Spain (some 20 million people).

¹¹ All the data in this section has been taken from the Labour Force Survey published by the INE, mostly that corresponding to the fourth quarter of 2019 (the latest data available for this work).

¹² This development reflects the provisions of the Petty-Clark Act. This law, initially drafted by William Petty and later refined by Colin Clark, states that economic progress is seen in the continued transfer of labour from the agricultural sector to the industrial sector and from the industrial sector to the service sector.

Another distinctive feature of the agricultural sector in terms of employment is its low rate of salaried contracts,¹³ thus, if in all economic sectors the rate is slightly above 84%, in the agricultural sector it does not reach 63% which is more than 20 percentage points below.

Lastly, as far as the labour market is concerned, of the 3.2 million unemployed counted at the end of December 2019, 184 thousand were among the agricultural sector (i.e. 5.8% of the total number of unemployed in Spain).

The main conclusion we can draw from this section about the importance of the agricultural sector in the labour market is its loss of importance since the middle of the last century.

2.3. Capital

The third of the production factors of agricultural activity that we will consider is capital. We will limit ourselves to a brief examination of the degree of mechanisation of this economic sector and of livestock population.

One of the most traditionally used indices to measure the degree of mechanisation of agricultural activity has been the tractor census. Over the last century, this figure has been around one million units, with an increasing trend over the period analysed (2006–2019) and an increase of 13% over the last 13 years. If we look at a broader period of the last 50 years, we see how the number of tractors used in our fields has quadrupled, increasing from 260 thousand units in 1970 to 1,128 thousand units today.

With regard to the livestock subsector, it should be noted that Spain does not enjoy particularly favorable conditions for livestock, due to the low rainfall in our country. The different rainfall figures recorded among the various regions of the peninsula determines a very uneven livestock development: more prosperous in the regions of northern Spain due to natural pastures (predominantly cattle), and a need for feed and fodder in drier regions of Spain (with a predominance of sheep, goats and pigs).

If we analyse the evolution in the number of heads, we can observe how in the second half of the last century sheep/goats (transhumant) were of greater significance in the whole of the cattle population, but their numbers decreased over time (from 26 million to 19 million) in favour of stables: pigs increased from 6 million heads in the middle of the last century to 30 million today; and cattle have almost doubled in that period from 3.6 to 6.5 million heads.

¹³ The rate of salaried contracts indicates the percentage of employees in a given market (Rate of salaried contracts = no. employees/no. employed × 100).

This historical evolution also shows a significant reduction in the number of animals used for agricultural work (horses, mules and donkeys), with a reduction from 2.5 million heads in 1940 to just 300,000 fifty years later.¹⁴

More significant than the evolution in the number of heads may be the analysis of the evolution in livestock production (heads slaughtered for meat and livestock for the production of milk and dairy products, fundamentally). It is empirically evident that capitalist modernisation of the agricultural sector (1950–1985) brought about changes in consumer preferences with respect to agricultural products due to an increase in per capita income. In particular, there was an improvement in diet with a greater demand for meat and milk. Undoubtedly, this increase in demand has been one of the factors explaining the increase in livestock production from the middle of the last century to the present day.¹⁵

Since the middle of the last century there has been a significant increase in the number of slaughters of poultry (an increase of more than 7000%) and pigs (an increase of more than 1600%), undoubtedly motivated by a price per kilo of this meat that is affordable for many consumers with not very high purchasing power. This is the case to a lesser extent in cattle (an increase of 120%), and we see decreases in the slaughter of sheep (–5%) and goats (–1%).

Apart from meat production, milk (and its derivatives) is another product of great importance in national agricultural income, with a growing production and exceeding 8,200 million litres in 2019. The annual production of eggs, with 1,100 million dozens, is another significant component of agricultural income along with wool (23,554 Mt), honey (36,394 Mt) and wax (1,904 Mt).

One of the problems of the Spanish livestock sector is the small size of its holdings. Thus, the number of heads per cattle farm is around 60, in sheep farms almost 250, pigs over 500 heads, and poultry less than 3,000 troops per farm. Although we are considering here a small livestock farm, given the small size of these farms, it is no less true that in recent decades there has been a resizing of said farms. As a result the size of livestock farms was much smaller 40 years ago with 10 heads per cattle farm (an increase of 531%), almost 100 in the case of sheep (165%), about 20 heads per pig farm (2.705%), and 160 birds per poultry farm (1.734%).

¹⁴ Not only has the modernisation of the agricultural sector contributed to this reduction in the number of horses, but also the modernisation of the armies, with the replacement of the cavalry as a military shock force and disuse as a means of dragging carriages and artillery. In recent years, however, horse breeding for leisure and even sport has increased.

¹⁵ It is no less true that in recent years there has been a trend in consumption to replace livestock products with plant products (vegan, vegetarian, etc.).

3. Spanish agricultural production value

After analysing the three productive factors of the agricultural sector (land, labour and capital), we move on to examine the value of Spanish agricultural production and agricultural income. The most relevant data are included in the following table, which we will briefly comment on.

The value of Spanish agricultural production today (based on data for 2019) is almost 51 billion euros. Throughout the period examined (1990–2019) we can see a growing trend in this variable, with an increase over the last 30 years of 108%, with production of agricultural income increasing from 24 thousand million euros to 51 thousand million. However, we must bear in mind that these values are measured in current terms. After considering the effect of price changes over time, this indicates a real term production value with a reduction of 2% over the last 30 years.

Of the four components of national agricultural production: crop production, animal production, agricultural services and non-agricultural secondary activities inseparable from agricultural activity, the most significant components in quantitative terms would be crop production and animal production. These two components alone account for nearly 97% of the total of this agricultural variable. Thus, over the last three decades the weighting of vegetable production (of total agricultural production) has been around 58%, and livestock production 39%. If we look more closely at these two components, we see that more than 50% of total plant production is composed of fruit and vegetables, as a result of growing demand for these products by citizens of the European Union. Next in importance (however far lesser) is cereal production (12% of total agricultural vegetable production), olive oil (9%), and fodder plants (7%).

With regard to the value of animal production the most significant element is meat production, comprising approximately 78% of total regional animal production – in particular pig meat (42% of total livestock production) and beef (15%). In addition, the significance of milk production (16% of animal production) and to a lesser extent eggs (5%) should also be noted.

The other agricultural macro-magnitude which we examine is the remuneration of the productive factors used in the agricultural activity branch, for instance agricultural income. The current value of this magnitude is 26,234.5 million euros (52% of the value of production in the agricultural industry).

Over the whole period analysed (1990–2019) this percentage has been significantly varied moving between 60% in 1995, and 42% in 2015. However, in absolute terms, if we observe a growing trend in the value of this magnitude, from almost 14 billion euros in 1990 to 26 billion in 2019, it has increased by just over 90%. Given this significant increase we could assume

that the income of our agricultural producers has almost doubled over the last thirty years, but again it is necessary to specify that this variable is measured at current prices. If we calculate the variation in real terms, once the effect of the price variation has been deducted, we see a reduction in agricultural income over the last three decades of more than 11%.

We can conclude this analysis of regional agricultural production by indicating that an increasingly significant component in the income of agricultural producers comes in the form of subsidies. These consist mainly of funds from the Common Agricultural Policy implemented by the European Union, with an increase in this item of more than 1800% (an increase from 292 million euros in 1990 to 5,635 million in 2019). Whereas these subsidies barely represented 2% of Spanish agricultural income in 1990, today they account for more than 20%.

4. Spanish agri-food industry in figures

At the beginning of this paper we referred to the traditional productive sectors (primary, secondary and tertiary). Today, many authors refer to the agro-food sector with regard to all those activities undertaken to obtain products of plant and animal origin, as well as to the industrial activities aimed at transforming these products. The latter constitute the objective of the agro-food industry; an industrial sub-sector which incorporates all activities involved in transforming products from agriculture and livestock and a link between those who cultivate the countryside and raise livestock and the consumers of these products.

The national agricultural sector occupies a preponderant position in Europe as a whole, as a top producer of cereals, potatoes, beetroot, wine, cow and sheep milk, and heads of sheep, cattle, goats and pigs. The quality and quantity of these raw materials also make Spain one of the leading regions in the agri-food industry.

However, not only is this industry significant at the national level, but also at the Community level. Starting with the latter, it should be noted that there are some 300,000 companies in the European Union engaged in this processing activity, employing more than 4.5 million people and, even more significantly, with a turnover in excess of 1 billion, making the EU food industry the main component of European manufacturing (with a production value of around 15% of total manufacturing output).¹⁶

¹⁶ *Annual National Accounts*, Eurostat, 2018, <https://ec.europa.eu/eurostat/web/national-accounts/data/database> [accessed on 15.09.2020].

At the national level, the agri-food industry is the main industrial branch with an output value of almost 115 billion euros. This industry represents 20.5% of the total industrial production value, and 23.8% of the production value of the manufacturing industry.¹⁷ The number of people employed in this industrial subsector exceeds 403 thousand. This represents 21.1% and 18.9% of the total number of people employed in the national industry, and in Spanish manufacturing industry, respectively. As far as agencies dedicated to this processing activity are concerned, Spain has more than 28,000 food and agriculture firms. This also represents 10% of all firms in the sector on the European level.¹⁸

If we analyse the evolution of the agri-food industry in Spain, it is worth noting that the relevance of this subsector in regional industry has increased in the last decade, since the proportion of those employed in this regional subsector throughout the industry of Castile and Leon has increased by 3.56 percentage points (from 25.2% to 28.8%). The proportion of turnover has also increased, in this case by 1.25%.

To conclude with this brief reference to the agri-food industry, we analyse trade relations with the outside world. According to the latest data published by the Secretary of State for Trade of the Ministry of Industry, Trade and Tourism, corresponding to 2018¹⁹ the value of exports of agri-food products in our country to the Community reached just under 46 billion euros. The value of imports of these products stood at 35 billion euros, meaning that the regional agri-food balance registered a positive balance of just below 11 billion euros.

The significant increase in exports during the period considered (at 84.1%), together with a much more moderate increase in the value of imports of these products (41.6%), means that over the last decade the positive balance of the national agro-food balance has increased by 6700%. Accordingly, the foreign trade coverage rate²⁰ of the agro-industrial sector has gone from 100% in 2007 to 131% a decade later.

¹⁷ *Estadística Estructural de Empresas: Sector Industrial. Avance 2017*, INE, 2018, https://www.ine.es/dyngs/INEbase/es/operacion.htm?c=Estadistica_C&cid=1254736143952&menu=ulti-Datos&idp=1254735576550 [accessed on 15.09.2020]. Datos, por lo tanto, correspondientes a 2017.

¹⁸ *Ibidem*.

¹⁹ *Anual Series 1995–2018*, Ministerio de Industria, Comercio y Turismo, 2018, <https://www.comercio.gob.es/es-ES/comercio-exterior/estadisticas-informes/Paginas/Informes-de-Comercio-Exterior.aspx> [accessed on 15.09.2020].

²⁰ The coverage rate expresses the percentage of imports that can be paid with the exports made during the same period of time; that is to say, it is the quotient between the value of exports and that of imports, multiplied by 100 as it is a rate.

5. Contributions of digitisation to the competitiveness of the sector

The statistical improvements that are beginning to be seen through this work have been due to large investments. These investments are currently represented by new information technologies for which the repercussions and returns from the use and application of such investments have already been demonstrated. The application of telematics and digitalisation in the production, industry and marketing of agri-foodstuffs is of vital importance for the competitiveness of this sector and, in turn, for the functioning of the European internal market and the achievement of the freedoms enshrined in the treaties. Moreover, these techniques in particular provide the necessary means of providing safer food and are also a way of guaranteeing sufficient supplies.

Above all, the most positive aspect of digitisation of this sector and its contribution to the competitiveness of the sector will be (through implications brought by “big data”) by creating new ways of structuring business under new operations, whilst at the same time reducing the environmental impact and improving the interconnection between rural areas. The process of digitization is another means to bring rural areas closer to urban areas and as such helping to achieve the objective of territorial cohesion. Such techniques also facilitate the variety of products, which has an influence on the access of and then passing on of costs. Of course, these also impact positively all that is related to environmental protection through the emergence of new types of agriculture, such as so-called precision agriculture.²¹ From the point of view of the agri-food sector, the application of digital technologies is not limited to these implications, since it also extends or influences other policies including those relating to the objectives of the new governance.²²

The Communication from the Commission to Parliament, the Council, the European Economic and Social Committee and the Committee²³ of the Regions on “the future of food and agriculture” warns that “research and innovation are at the heart of progress on all the challenges facing the EU’s rural areas and agricultural sector: economic, environmental and social. The needs and contributions of rural areas must be clearly reflected in the research agenda of the European Union, and the future CAP (Common Agricultural

²¹ Developed in E. Muñiz Espada, *Derecho agroalimentario y ciberseguridad*, Madrid 2019.

²² J. Leone, *Towards new digital insights. The value of open data for food information in Europe*, “Rivista di Diritto Alimentare” 2017, No. 3, pp. 4–5.

²³ COM(2017) 713 final, p. 14.

Policy) will have to further improve synergies with research and innovation policy in relation to promoting innovation. Technological development and digitisation allow major steps to be taken in the field of resource efficiency by improving climate and environmentally-smart agriculture, which reduces the impact of agriculture on the environment and climate, increases soil resilience and health and reduces costs for farmers. However, the uptake of new technologies in agriculture remains below expectations and is not present in consistent measure throughout the EU and there is a specific need to address access to technology for small and medium sized farms. Not only is technology below expectation, but also access to sound, relevant and new knowledge is very uneven across the Union, hindering the functioning of certain CAP instruments and holding back the development potential and overall competitiveness of the agricultural sector. In contrast, the CAP's ability to increase the flow of knowledge between partners in different parts of the EU offers strong added value as it will save costs, increase the impact of EU funding and accelerate innovation in different parts of the EU."

These will be issues of particular concern in the forthcoming CAP reform, however the current programme already encourages and benefits technological applications including those for the management of CAP subsidies. Additionally article 45 of Regulation 1305/2013 of the European Parliament and of the Council, of December 17, 2013²⁴ on support for rural development by the European Agricultural Fund for Rural Development encourages the acquisition or development of software as an eligible expenditure that can qualify for Reader support, in order to develop a rural policy to accompany and complement direct payments and market measures of the CAP and thus contribute to achieving the objectives set out in the TFEU.

Let us recall that article 39 of the TFEU, which guides and guarantees the agri-food policy, insofar as "the objectives of the common agricultural policy shall be:

a) to increase agricultural productivity by promoting technical progress and by ensuring the rational development of agricultural production, as well as the optimum use of the factors of production, in particular of the labour force;

b) to guarantee a fair standard of living for the agricultural population, in particular by increasing the individual income of those working in agriculture;

c) to stabilize markets;

d) to guarantee security of supply;

e) to ensure supplies to the consumer at reasonable prices.

²⁴ Modified by the "Reglamento de 17 de mayo de 2017" and the "Reglamento Omnibus."

In working out the common agricultural policy and the special methods which it may involve, account shall be taken of:

- a) the particular nature of agricultural activity, which results from the social structure of agriculture and from structural and natural disparities between the various agricultural regions;
- b) the need to effect appropriate adjustments gradually;
- c) the fact that, in the Member States, agriculture constitutes a sector closely linked with the economy as a whole.”

This does not imply that a rational agri-food policy has always been followed.

Undoubtedly, the future of agriculture depends essentially on the expansion of these means, which will strongly condition (as has already been noted) the models of farming, the sectors of production, agricultural practices, the type of professionalisation of the farmer and, in short, the superiority and leadership of a country with respect to its geographical context. Undoubtedly, competitiveness in the agricultural sector cannot be understood without the application of such new-generation digital technologies.²⁵

However, the risks are high, as is always the case with any new technological process, which is why protocols and legislation are needed to prevent and respond to cyber-attacks, including cyber-terrorism or agro-terrorism against food production. The issue is not only of importance for public health, but also for the economy, the environment, and State security along with companies within the sector, since the great revolution of our time is the use in production and in the food industry of all equipment, operations and processes associated with information technology, computing devices and the “Internet of things.” In this field, it is also essential to have a unifying regulation, which overcomes any kind of regulatory fragmentation.

These regulations are present on a general scale, both at the national and European level, but the question is whether a specific regulation of this nature should be promoted for the agricultural and agri-food area, since the problem affects public health and the traceability of foodstuffs and their quality.²⁶ This specification may also be justified under the principle of agricultural exceptionality, although it may be increasingly questioned.

²⁵ See A. Jannarelli, *Il divenire del diritto agrario italiano ed europeo tra sviluppi tecnologici e sostenibilità*, “Rivista di Diritto Agrario” 2013, pp. 12, 21; W.H. Ware, *Security and Privacy in Computer Systems*, 1967, cit. by T.J. Misa, *Communities of Computing, Computer Science and Society in the ACM*, Minneapolis 2017; *Report United Nations by the Independent Expert Advisory Group on a Data Revolution for Sustainable Development*, November 2014; *A World that Counts Mobilising the Data Revolution for Sustainable Development*, IEAG, November 2014.

²⁶ Broadly in E. Muñiz Espada, *Derecho agroalimentario...*

From the legal point of view, the issue of data ownership that arises from the use of information applied to these digital media is also at stake, such as data ownership and portability, access, interoperability, transfer and circulation, data exchange through platforms and control of these platforms, accountability, sustainability of innovation in new business models, or, most essential, that of food safety.²⁷

To these issues adds, in fact above all, the problem of cybersecurity. Cybersecurity has become essential given the dependence on computer and electronic means in agricultural production that directly affect food security. The multiplicity of data and processes implies an increase in risk and the existence of new types of contingency, for example new sources of fraud and cybercrime.²⁸ However, despite the importance of the security of computer systems, there is, in addition to an excessive fragmentation in the general treatment of the entire issue of cybersecurity and its implications, a lack of legal provisions and legal protocols for action specific to the agri-food sector that are important to ensure the principle of traceability and precaution.²⁹

In any case, the current challenge is the safe application to the agricultural and agri-food environment of digital technologies and tools for agricultural production and industry, since these techniques are particularly threatened by vulnerability and the ease of breaking their security. In this respect a legal framework for their prevention and protection could be part of the solution. This is an issue which must be considered through (to begin with) “legislative policy actions” but go beyond the current strategic plans for critical infrastructure or general security. In addition to the complexity of this

²⁷ On property and this data see P. Lattanzi, *L'agricoltura di fronte alla sfida della digitalizzazione. Opportunità e rischi di una nuova rivoluzione*, “Rivista di Diritto Agrario” 2017, No. 4, pp. 561–563; L. Capote Perez, *Ciberseguridad, big data y propiedad intelectual*, in: E. Muñoz Espada (ed.), *Sector agroalimentario: Ciberseguridad y desarrollo sostenible*, Madrid 2020, pp. 115–116.

²⁸ J.C. Gamazo Chillón, *La ciberseguridad. Premisas iniciales: de amenaza a oportunidad*, in: E. Muñoz Espada (ed.), *Sector agroalimentario...*, pp. 65–66.

²⁹ Perhaps this can explain the slow process and evolution in the use of such technologies in Spain, such as drones, GPS, geolocators, agronomic management systems, among others. Three factors point to C. Valero Ubierna, A. Moya Gonzalez, *La agricultura digital*, “Tierras: Agricultura” 2018, Vol. 266, pp. 14 and 15, as limiting the progress of the adoption of these techniques: the incompatibility of the equipment: in the first phase of implementation there were problems of compatibility between equipment of different brands, and even between equipment of the same brand, which causes problems when carrying out field work, but the progress made in the standardisation of connections and communications protocols has made it possible to reduce incidents; secondly, another problem is the difficulty of use, although farmers are increasingly trained to make use of these systems; and another problem is adaptation to local needs, since the agricultural reality in the different production areas is not the same.

aspect of digitisation, there is also its global dimension or the impossibility of guaranteeing internal security if not linked to security also outside one's own borders, especially in coordination with a European policy.

Any common space, such as cyberspace, is characterized by its easy accessibility and interconnection, but in its very ease of access lies its risk. This affects data protection and property, and lends itself to irregularities in dissemination and criminal actions, which in our case could go as far as agro-terrorism, with consequences not only for health or national services or interests but also for the competitiveness of agri-food companies. In order to neutralize these elements, it is a given fact that regulation is anticipated and that there be a legal system of prevention and a system of control and integral protection, which would include a regime of responsibility. In short, a legislative development is required, which together with basic security regulation, is accompanied by a specific sectorial regulation.

The Royal Decree 1008/2017, of December 1, which approves the Spanish National Security Strategy 2017, has the following objectives: "to guarantee the safe use of information and communication networks and systems by strengthening the capacity to prevent, detect and respond to cyber-attacks, promoting and adopting specific measures to contribute to a safe and reliable cyber-space. To strengthen capacities for prevention, detection, reaction, analysis, recovery, response and investigation of cyber threats, as well as to strengthen coordination at the technical and strategic levels of the National Security System in the area of cybersecurity." Reinforce, boost and promote the regulatory, organizational and technical mechanisms, such as the application of measures, services, good practices and continuity plans for protection, security and resilience in the public sector, strategic sectors, the business sector and citizens, so as to guarantee a safe and reliable digital environment. To reach the necessary technological capacities by means of the impulse of the Spanish industry of cybersecurity, promoting an environment that favors the investigation, the development and the innovation, contributing to the security of the cyberspace in the European and international area, on the base of the collaboration and the mutual aid.

In addition to these regulations, Law 36/2015, of September 28 on National Security, contains the basic rules for public authorities to fulfill their obligations to guarantee the freedom and prosperity of society, the stability and proper functioning of its institutions, including the protection of critical infrastructure, as stated in its preamble.³⁰

³⁰ The President of the Spanish Government has now signed the new National Defence Directive 2020. This document establishes the Ministry of Defence's lines of action and objectives for

Likewise, as a consequence of Directive 2008/114, of December 8, on the identification and designation of European Critical Infrastructures, Law 8/2011, of April 28, which establishes measures for the protection of critical infrastructures, regulates (as its preamble explains) the actions necessary to optimize the security of infrastructures that are mainly in the area of protection against deliberate attacks and It deals with the protection of critical infrastructure against deliberate attacks of all kinds, including the definition of an organizational system for the protection of such infrastructure affecting public administrations and private entities. To this end, the National Center for the Protection of Critical Infrastructure has been created.

The Critical Infrastructure Protection Regulations approved by Royal Decree 704/2011, of May 20, develops Law 8/2011, of April 28, by virtue of which the Secretary of State for Security approves the minimum contents of the Operator Security Plans and the Specific Protection Plans, so that by Resolution of September 8, 2015, of the Secretary of State for Security, the new minimum contents of the Operator Security Plans and the Specific Protection Plans are approved.

Thus, a procedure and organization based on five plans has been established: the National Plan for the Protection of Critical Infrastructure (PNPIC), Sectoral Strategic Plans (PES), Operator Security Plans (PSO), Specific Protection Plans (PPE) and Operational Support Plans (PAO).

As the use of cyberspace knows no borders, a European dimension to help manage these risks is developed from a European Programme for Critical Infrastructure Protection. For the Green Paper on a European Programme for Critical Infrastructure Protection “effective protection of critical infrastructure requires communication, coordination and cooperation at both national and EU level between all stakeholders: infrastructure owners and operators, regulators, professional and business associations in cooperation with all levels of government and the general public.” It would be a matter of “ensuring adequate and equivalent levels of security for critical infrastructure, minimising points of failure and proposing rapid and proven infrastructure recovery mechanisms for the whole Union.”³¹

At the European level, attempts have been made to reinforce security through various directives including Directive 2013/40/EU of the European Parliament and Council of August 12, 2013, on attacks against information systems, Directive EU 2017/541 of the European Parliament and Council, of March 15, 2017, on terrorism, Directive 2014/41/EC of the European

this legislature, in addition to initiating the new cycle of Spanish defence planning, which is rooted in the National Security Act of 2015 and the National Security Strategy of 2017. DSN.gob.es.

³¹ COM(2005) 576 final.

Parliament and Council, of April 3, 2014, on the European Criminal Investigation Order, Directive 2014/57/EU of the European Parliament and of the Council, of April 16, 2014, on criminal sanctions applicable to market abuse or Market Abuse Directive, EU Directive 2016/1148, of July 6, 2016, which aims to ensure a common level of network and system security; and on data protection and information security risks, Regulation EU 2016/679 of the European Parliament and of the Council, of April 27, 2016, on the protection of individuals with regard to the processing of personal data and on the free movement of such data, is also taken into account.

The Royal Decree-Law 12/2018, of September 7, on network and information system security transposes into Spanish law Directive 2016/1148 of the European Parliament and of the Council, of July 6, 2016. Its purpose is to regulate the security of networks and information systems used for the provision of essential services and digital services, and to establish an incident notification system. It also establishes an institutional framework for the application of this Royal Decree-Law and the coordination between competent authorities and with the relevant cooperation bodies at the Community level.

Thus, the general approach to guarantee security lies in a staggered response, focusing on the exchange of information, cooperation, incident notification, and the appropriate organization for the prevention, detection and response to such incidents, prior to the implementation of techniques for the identification of threats.

However, the question that an agrarianist can raise is whether this regulation on cyber-security and all the legal issues arising from the use of such technologies should be general for all sectors and markets, or whether the agri-food sector should have specific protocols for action due to its essential role as a basic and primary sector, which would not mean imposing new obligations on the agricultural entrepreneur or on farms, but rather an opportunity to participate in a more competitive market at international level.

6. Conclusions

This paper shows the quantitative and qualitative importance of the agricultural and agro-industrial sector in the Spanish economy. The value of Spanish agricultural production today is almost 51 billion euros, with an increase by 108% over the last 30 years, with production of agricultural income increasing from 24 thousand million euros to 51 thousand million. Of the four components of the national agricultural production, the most

significant components in quantitative terms would be crop production and animal production. These two components alone account for nearly 97% of the total of this agricultural variable. Thus, over the last three decades the weighting of vegetable production (of total agricultural production) has been around 58% and of livestock production it was about 39%. Nowadays, the Spanish agricultural sector occupies a preponderant position in Europe as a whole, as a top producer of cereals, potatoes, beetroot, wine, cow and sheep milk, as well as heads of sheep, cattle, goats and pigs. The quality and quantity of these raw materials also make Spain one of the leading regions in the agro-food industry.

The increases in the results as indicated above required a greater competitiveness in respective areas of production and the competitiveness in the agricultural sector cannot be understood and continued without the application of new-generation digital technologies. However, the risks are high, as is always the case with any new technological process, which is why protocols and legislation are needed to prevent and respond to cyber-attacks. In this sense, it must be considered and monitored through “legislative policy actions” and go beyond the current strategic plans for critical infrastructure or general security. The authors understand that a specific regulation of this nature should be promoted for the agricultural and agro-food area since the problem affects public health and involve the traceability of foodstuffs and their quality. All this, however does not imply new obligations on the agricultural entrepreneur, but rather an opportunity to be created for producers to operate successfully in a more competitive market.

DIGITISATION IN AGRICULTURE AS A FACTOR OF COMPETITIVENESS

Summary

The authors underlie the qualitative and quantitative importance of agriculture and the agro-industrial sector in the Spanish economy analysed in the light of existing legal regulations and claim that a further development of the agricultural sector will only be possible when new information technologies and the Internet are implemented. Their application is one of the main challenges for the agro-industrial sector in the near future. These challenges justify posing questions about legal regulations on issues such as the ownership and storage of data that relate to the application of new technologies, access to, transfer and circulation of these data, the exchange of data through Internet platforms and the control over these platforms, the responsibility thereof, forms of doing business in the context of the application of new technologies, or, as seems to be the most important, cyber-security.

LA DIGITALIZZAZIONE IN AGRICOLTURA COME FATTORE DI COMPETITIVITÀ

Riassunto

L'articolo si propone di presentare l'importanza quantitativa e qualitativa del settore agricolo e agroindustriale per l'economia spagnola alla luce delle normative in vigore. Secondo gli autori, un ulteriore sviluppo del settore agricolo sarà possibile solo ricorrendo alle nuove tecnologie informatiche e alla rete internet. La loro applicazione è una delle principali sfide per il settore agroindustriale in un prossimo futuro. Le sfide in oggetto contribuiscono, tuttavia, a sollevare interrogativi sulla regolazione giuridica di questioni come la proprietà e l'archiviazione dei dati relativi all'uso di nuove tecnologie, inclusi l'accesso ad essi, il loro trasferimento e la circolazione, lo scambio attraverso piattaforme online e il controllo delle stesse, la responsabilità, forme di attività economica nel contesto dell'applicazione di nuove tecnologie e, come sembra, la più importante tra le questioni elencate – la sicurezza informatica.