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The Rediscovery of the Pig: Zootechnical Aspects and Management Problems of Pig Farming in Italy between the 19th and 20th Centuries

El redescubrimiento del cerdo: aspectos zootécnicos y problemas de gestión de la cría de cerdos en Italia entre los siglos XIX y XX[1]

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Resumen

La transición del estado silvestre al sedentario representa un primer cambio en la práctica agrícola, al que le siguió la difusión de las prácticas de los ganaderos sobre el mejoramiento de razas y estudios específicos en el campo zootécnico para un mejor rendimiento de la productividad de la carne de cerdo; con el tiempo, la cría familiar fue reemplazada gradualmente por la industrial e intensiva. En algunos casos, la demanda de carne con un contenido graso cada vez más bajo también empuja a los agricultores a recuperar el antiguo sistema de pastoreo libre en el bosque con una dieta a base de castañas y bellotas para obtener una auténtica y calidad. Los estudios sectoriales son cruciales tanto para el desarrollo del sector como para reflexionar sobre los problemas típicos del sector cárnico y de procesamiento. Luego el enfoque se traslada a la profundización de la legislación nacional y europea para identificar las fortalezas y debilidades del sector con una mirada al impacto ambiental y la oportunidad de las empresas ganaderas de adoptar plantas específicas para la transformación y uso de residuos animales en biogás, con grandes ventajas energéticas y medioambientales.

Palabras clave: cerdo, cadena de suministro de carne, legislación, Italia.

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Abstract

The transition from the wild to the sedentary state represents the first change in farming practice which was followed by the dissemination of the practices of breeders on the improvement of breeds and specific studies in the zootechnical field for a better yield of pig meat productivity. The family-run breeding was gradually replaced by the industrial and intensive one. The demand for meat with an increasingly low-fat content has also pushed farmers to recover the ancient system of free grazing in the woods with a diet based on chestnuts and acorns to obtain a genuine and quality. Sector studies are crucial for the development of the sector and to reflect on the typical problems of the meat farming and processing sector. The focus then shifts to the deepening of national and European legislation to identify the strengths and weaknesses of the sector with a look at the environmental impact and the opportunity of livestock companies to adopt specific plants for the transformation and use of animal manure in biogas with great advantages in terms of energy and environment.

Keywords: pig, meat supply chain, legislation, Italy.

Introduction

Massimo Montanari (1984) citing a work of Louis Bourdeau (1894) reflects on the importance of material culture and presents the pig as a symbol of the ancient agro-food civilization, the emblem of the festival of "fat" and collective culinary imagery (Malossini and Loszack, 2014).

During the Medieval Age, pigs were left to freely roam in their wooded environment, feeding on acorns and roots, while at other times they wandered undisturbed in urban settings scavenging for food residues. Today's domesticated pig differs from its descendant, the wild boar; it has become developed for purposes of propagation and as an animal that is intentionally fattened to especially serve as food throughout the year for rural families. The management of pork meat production, which included pig fattening, was often entrusted to the swineherder (Montanari 1979, 1984; Baruzzi and Montanari, 1981).

Because of its predisposition for fattening, the pig has historically swerved a dual purpose: first, as a source of income for the rich, and second, as a reserve of food for the poor, who preserved its meat using salt. In economic terms, it represents the oldest livestock industry (Montanari, 1984). For the Latin agronomists, the pig was the symbol of an abundant and joyful life and they celebrated its qualities in their extravagant poems targeted to farmers with instructions involving agricultural and breeding practices (Ferrari, 1761; Frizzi, 1772; Onorati, 1854; Columella, 1947; Varrone, 1992; Emiliano, 1998).

In 1815, the Count Filippo Re, a professor of botany and agriculture at the University of Modena, published his work entitled *Nuovi elementi di Agricoltura*, and in volume IV, chapter XI he dealt with various aspects concerning the breeding of pigs: "of the pigsty, of the choice of the boar, the quality of the sow, advice on the mating, of the pigs, of the suitable food and drink for this herd, of the fattening of pigs, indications on their illnesses" (Re, 1815: 207). Filippo Re, who already in 1809 had compiled the *Annali di Agricoltura del Regno d'Italia*, in just a few pages gathered information on the conditions of the woods and on pig breeds, set out the practices

to keep enclosures clean, and noted the importance of providing good feed, the preference for acorns and wild chestnuts and the prohibition in some Milan states to use the pomace or walnut that influenced the quality of meat, causing the sausage to turn rancid.

The Italian pig in the 19th century

The first treatises on pig breeding were limited to the distinction of breeds from the white, red and black color of the coat, to the conclusion that the latter two supplied the finest meats. The interest in developing the rural economy would be enlightened over the following years by observations, studies, and memoirs addressing to pig farmers, knowledgeable about animal feed, reproductive techniques, meat processing, and gastronomy (Margaroli, 1851). However, above all, research focused on indigenous breeds and the livestock situation in Italy (Motti, 1888; Marchi, 1897, 1914; Faelli, 1903; Alberti, 1906; Mascheroni, 1927; Pergola, 1945; Corio, 1963).

The appearance and quality of the meat were concluded to depend upon the pig's diet: from the color of the leathery skin covered with hard or soft bristles that fade from black to red-brown, to the body that ranges from an elongated shape to a more compact one as well; the long or short ears, though strong, muscular legs; and the snout, which is longer in the scavenging animals and less pronounced in more domesticated breeds that have been reared within stables and pigsties.

Until at least the second half of the nineteenth century, the diet of Europeans was based solely on cereals. Meat consumption was the privilege of the city's elite. Subsequently, the consumption of meat by families progressively increased hand in hand with zootechnical improvements aimed at improving the quality of the meat, the introduction of innovative conservation techniques, the acceptance and practice of stable farming, the establishment of public abattoirs that guaranteed compliance with hygiene rules during processing and improved means of transport. Consumption thus changed and immediately confirmed that one of the urgent problems to be faced was selecting the breeds, since each region of the peninsula had one or more pig breeds also with different morphological characteristics which were dependent upon climatic and environmental conditions. The first manuals of practical ideas on pig breeding date back to the nineteenth century (Stanga, 1915).

The art of pig farming lies in the feeding dairy written by the Marquis of Crotta d'Adda (Cremona) in 1815, documenting that successful breeding depends on the experience of the breeder and the diffusion of his knowledge taking into account environmental diversities including soil, climate, food availability and financial resources because "zootechnics change even at a distance of one kilometer" (Stanga, 1915), and each farmer, as with the viticultural industry, must adapt each unique situation to the real conditions in which he works.

Pig farming is a profitable activity; the renowned saying "nothing goes to waste with a pig" should be completed with "and even the pig refuses nothing" because being an omnivorous animal, it eats everything. Therefore, its diet is not subject to the high prices of food sources and the agricultural environment they constitute.

In this regard, Idelfonso Stanga writes that in his breeding farm pigs follow a diet of few foods and recommends the breeder to "adapt and use" his practical advice. The profits of the livestock depend on the cross breeding that allows obtaining breeds of strong and fertile constitution: a good breeder should know how to choose the purebred pigs suitable for crossbreeding and English breeders were considered the best because they bought boars from trade shows so they could know where breed came from.

Among native Italian pig breeds, there were two important breeds in the Piedmont: "Cavour" bred on the plains and hills of Asti, Alessandria and Monferrato, and "Garlasco", typical of Lomellina and upper Novarese. Expert Piedmontese agronomists like Lascaris, Magnone, and Cavour, attempted to import a "Siamese" breed, a spotted Asian pig, small with thin and short legs, fine bristles, along with an "Anglo-Chinese" breed, but their poor upkeep over time led to the breed's extinction Breeding in Piedmont was not very expensive because pigs were left to pasture and were supplemented with household leftovers or wheatmeal that was unsuitable for human nutrition (Enciclopedia Agraria Italiana, 1880).

The Piedmontese pigs, despite being an easy breed for fattening and with fine meat and lard, did however not flesh out during the summer months with this kind of feed unlike the pigs bred in Lombardy: Milanese breed was fed with surplus of *Bergamine*[3] and cheese manufacturing.

It was the dairy industry that gave a boost to pig breeding. Usually, in the first phase of their life, pigs were left to graze in fields or in the woods and were ultimately confined to stable areas. To make the most of scraps and leftovers, cheese factories and dairies in northern Italy combined their main activity with the breeding of pigs, especially suckling pigs or *magroni*.

In a second phase, specifically the fattening, adult pigs, boars, and sows were kept in pigsties both to favor their reproduction and to fatten them with foods based on acorns, flour, and fatty alimentary waters, waste fruit, and vegetables. Italian fattening techniques were adopted in pigs from birth, above all in cheese factories. English breeders were already following an intensive kind of breeding.

Italian native breeds

In the Parma and Piacenza regions, the Parmese breed existed, which was easy to fatten, and was described by Pietro Del Prato, professor at the Faculty of Veterinary Medicine of the University of Parma, as producing exquisite meats suitable for preservation with salt, "outcome of the black breed with large ears" which did not require crossbreeding with the Anglo-Chinese breed (Del Prato, 1869). Then there are the Romagnola breed (Mora or Castagnona), Forlivese, Faentina, Riminese and the Roman breed. They are more rustic than the others with a smaller head but resistant to soil conditions and diseases such as malaria. In Tuscany, the Maremmana or Macchiaiola breeds were left to graze in the wild on the scrubland. However, feeding on shrubs hindered their fattening and this breed also became extinct along with the Mediterranean scrub, attributed to land reclamation for farming.

3 The Bergamine were transhumant shepherds from the Bergamasco valleys who were involved in the production and processing of milk.

Instead, the Cinta Senese (see the late medieval murals by Ambrogio Lorenzetti, *The Allegory of good and bad government,* kept in the town hall of Siena) was very widespread: a black breed with a white band around the chest, bred in the woods and fed on acorns, tubers, and other subsoil products; a rustic animal with a marked grazing activity whose characteristics were considered suitable for national swine production. Indeed, in 1934, the Agriculture Inspectorate of Siena began to handle its improvement.

Among Italian breeds, the Casertana (Napoletana, Pelatella) has always been the most appreciated, as is the Pugliese breed, which is very similar and is left to graze wild so much so that it very much recalls the wild boar. The British imported it for the improvement of the Berkshire breeds. From England, they were imported into Italy where they were considered the best of the Yorkshire breed. The king in his residence in Venaria Reale possessed a herd of this breed called Anglo-Chinese (Enciclopedia Agraria Italiana, 1880: 373).

The Pugliese breed has a characteristic white coat and is bred in Puglia (Murge), in north-eastern Lucania, and in Campania. In these regions, the Cavallina also is bred, with its typical dark coat and white-tipped bristles; it is slow-growing and provides tasty meats with low fat. The Calabrese breed, with its Reggitana, Cosentina, and Lagonegrese varieties (Bonadonna, 1951), the Sicilian breed—not very prolific—and moreover the scarcity of the woods on the island, has not favored the development of the breeding that would in any case not be very profitable.

The Sardinian breed pigs resemble small, slow-developing wild boars and were trained as guard dogs. The breed was improved with crosses with the French Craonnaise pig and with the Yorkshire, Berkshire and Casertana breeds.

The Marchesina, bred in Lucania, Basso Molise, and Capitanata, which also constitutes a primitive breed, is slow to fatten and moreover not very prolific. To achieve improvements, attempts were made to crossbreed with other breeds but in any case, without appreciable results, which led to the consideration that to obtain a better yield, it would have been preferable for this breed to be raised domestically.

Italian pig breeds were suppliers of lard whereas English pig breeds above all provided meat. There was a need to have a breed with the right proportion of meat and lard, and so in 1873 the *Deposito di animali miglioratori* (Depository of Improver Animals), managed by Antonio Zanelli, intervened in the breeding of the species by importing English Large White and Yorkshire pigs to improve breeds and obtained the Middle White breed.

First attempts of improvements

Antonio Zanelli was born in Chieve sul Cremasco on April 3rd, 1825, and in 1870 he was director of the chair of agriculture at the Technical Institute of Reggio Emilia and then director of the Reggio Emilia Dairy and Livestock School (Ricchetti, 1894). He was the juror at livestock shows, in Vienna in 1873 and in Paris in 1878. In 1879, he dealt with the conditions of pastoralism in Sicily and Sardinia, and subsequently obtained from the government the possibility of establishing the Depository and import English breeding pigs, Large White and Yorkshire breed to have Middle White breed.

All of Zanelli's zootechnical studies and conferences on the importation of foreign livestock from Switzerland, Holland, and England and the observations on breeding crosses were compiled into printed publications and the Depository was transformed into an Experimental Animal Husbandry. In 1886, the Italian breed was crossed in Faenza with the English Yorkshire and two new breeds were created, San Lazzaro and Bastianella: the pigs were tall, with dark skin, thick and black bristles, and had ears almost as long as those of rabbits.

The native Italian breeds adjusted well to the woodland environment. They fed on acorns and wild chestnuts and provided excellent meat despite the low weight and lack of fertility. The cutting back of the woodlands prompted the phase of breeding in pigsties, using mixes of flour and milk residues from the dairies established in the north, to the detriment of the goodness of the meat and the lard of whose consumption was reduced in favor of other animal fats like butter.

Breed improvement and the disappearance of native breeds

In the nineteenth century, England was one of the main producers of pig breeds and the most specialized in their improvement; it exported breeds and crossed them with indigenous breeds in the counties of York, Lincoln, and Norfolk.

Due to the repeated crossings, starting with the White breed, the White Suffolk, Norfolk Lincolnshire, and lastly Yorkshire (or English white straight-eared breed), breeds were developed, from which the three large, medium and small sub-races then emerged. The large white-pink Yorkshire breed comes from the improved ancient pig of York County, that was imported to Italy in 1872.

During this evolutionary period in experimentation, many breeders declared themselves against the crossing of breeds on the grounds that although the problem of faster reproduction would be solved. Any economic advantage would be lost due to the process involving the speed of fattening, which was though to negatively affect the meat's quality (Alberti, 1906; Tampellini, 1905; Marchi and Pucci, 1923).

The importation of English pig breeds by crossbreeding was also much criticized by Andrè Sanson, a professor of animal husbandry at the Grignon National Agricultural School, who in his *Treatise on Animal Husbandry* (Sanson, 1887) opposed theories on the evolution of the species. Zanelli himself had doubts about the profitability depending on the cost of production, the quality of the meat, and the convenience of breeding, claiming that even if the breed reached a considerable weight, this did not correspond to the amount of food ingested. These breeds were raised in stables by the *Stomerkerds* or reproducers on behalf of foreign exporters who asked for animals of greater weight and did not take the cost of production into consideration. But since they fattened easily, they had a reduced reproducibility and yielded a lot of fat which was a disadvantage for Italy, a country that produced hams and cured meats.

The medium Yorkshire breed includes the pig Coleshill, Cumberland, White Suffolk and the Windsor, which was born from repeated crossings between 1846-1851 in the royal estates: finally, from the crossing of the Chinese boar with the indigenous white pig, the Yorkshire small breed was created: New Leicester or Middlesex, Dishley, Small Yorkshire by the Americans. In 1885, Zanelli imported two specimens of a female and a male from the French breeder, the Marquis Leoncourt.

The Yorkshire breed is among the most prized breeds, obtained by crossing indigenous pigs and Chinese and Siamese pigs imported to England at the end of the 18th century by the breeder Bakewell. From the various crosses between pure and mixed breeds (Baldassarre, 1899), from the largest to the smallest, sub-races were created: Large White (Lincolnshire, White Suffolk), Middle White, and Middlesex. The Essex and Middlesex races were imported into France to make crosses with native breeds (Enciclopedia Agraria Italiana, 1880: 379).

The Large White is a very valuable meat breed that ensures very high profits and is used above all for the production of bacon. The introduction of this breed is owed to the breeder Joseph Tuley (Bonadonna, 1951:1784). In the 1930s, the Large White was still the best breed in the "Tonnage Contests" of the Milan Trade Fair.

In the eastern English counties and especially in the County of Lincoln, in the famous "Duckering Farms", the Large White was further crossed with other breeds such as Berkshire, Middle White, Saddleback, Large Black, and Tamworth. Tamworth is perhaps the oldest pure English breed imported in the nineteenth century from Leicestershire, Staffordshire, and Northamptonshire, first into the United States and later into other European countries: a dark red pig (mahogany) that grazed in the forests of the Midland county, but when the woods were transformed into agricultural fields it was crossed with less wild breeds like the white pig but the white, black and gray crosses were not highly appreciated. In Italy it was not widespread.

The Middle White breed is a prolific and long-living breed whose introduction is due to the breeder Sanders Spencer and E.O. Whetam, of the Cambridge School of Agriculture, published in the *Pig Breeders' Annual* that the slaughtering yield of Middle White pigs exceeded 70%.

In the nineteenth century, in West Berkshire Casertana pigs were bred with Chinese pigs: a new breed called Berkshire was born from the name of the place where the cross was made: whose pigs were black, white-spotted. The Berkshire breed has always been considered the most important breed in England and the ancient breeders mated them with wild boars. In the second half of the century, English breeders began to select breeds to breed with Chinese pigs, Chinese and Neapolitan mestizos and they obtained robust animals with shorter heads and longer ears. The first breeders to experiment with the crosses were Riccardo Astley of Oldstone-Hall, Lord Barrington, and Sherard. In 1884, the first society for the Berkshire was founded, the "British Berkshire Society"; and in 1899, the "Large Black Pig Society" was established for the Large Black breed, to guarantee the standard of the breeds.

In 1913, the Gloucestershire Old Spot was obtained from the crossing of the White Large and Large Black. In 1836, Mr. Queen raised 18,270,000 heads for a value of 456.750.000 Italian Lira. As for Italian pork consumption, this amounted to 6 kg per person each year, corresponding to 2/3 of the animals raised in the country, while in France consumption was 11 kg per person each year.

Italy has never imported pigs from France, Switzerland, or Germany because it had superior quality breeds. From Emilia Romagna processed meats were exported such as hams, *biandole* and salted lard that were transported in tin boxes. Italian cured meats were affected by competition from American cold cuts. In North America, the commercial houses slaughtered 50,000 pigs a day (from November 1st, 1872, to April 30th, 1873, the "Pork Packer's" slaughtered more than 5 million pigs. In Chicago, there were 40 companies for salting meat of which only 8 worked exclusively for Europe, where they imported only processed pork with a value of more

than 200 million Italian Lira a year. In 1878, the price of American salted pork was 80 cents/kg in Paris. The British government stipulated contracts with speculators from Ontario and Canada for fresh American meat supplies for troops based in Cyprus and Gibraltar (Rastoin and Ghersi, 2010).

Italian exports of pigs benefited foreign breeders who reimported them after fattening, taking advantage of the price. But Italy was also a producer of pork; at the Paris Exposition of 1878 there were the "Fratelli Bassi" of Bologna who presented salted meats in tin cans, "Forni" hams, Carulli's salami *monstre* and for tin cans, the "Bolognese Society". On that occasion, the Royal Higher School of Agriculture of Portici received "une mention très honorable" for boars and sows of the Theanina or Casertana breed.

After the first "statistic" that coming from the data of the Paris Exhibition, other statistics were published by the Ministry of Agriculture, Industry, and Commerce in 1875 reported by Maestri in *L'Italia economica* (Ministero degli Interni, 1878). The census began in January 1869 and due to coinciding with the corn duties the data are not reliable because it was feared that a new tax would be introduced, this time on cattle. Furthermore, there are no data from Rome and its provinces that had not yet been annexed to the kingdom: 1,553,582 pigs, of which about 50% were fattening pigs and the other 50% piglets (34%), sows (14.3%), and boars (1.7%).

From the Yearbook, it is also possible to extract data on Italian pork imports and exports in the five-year period 1862-1877 (Table 1):

Table 1. Imports and exports of pigs (1862-1877)
Tabla 1. Importaciones y exportaciones de cerdos (1862-1877)

Year	Imports	Exports
1862	5.148	42.245
1863	23.566	19.981
1864	7.570	15.049
1865	8.603	17.181
1866	6.448	44.807
1867	4.843	81.677
1868	4.981	85.891
1869	7.714	65.978
1870	3.940	76.086
1871	3.220	177.545
1872	3.515	105.186
1873	5.925	53.678
1874	6.124	50.492
1875	4.455	37.652
1876	4.370	115.037
1877	4.247	130.251
Tot.	104.699	1.118.736

Source/fuente: Il Coltivatore, 1897: 538-539.

After the First World War, the indigenous races disappeared completely while the crossbreeds with the English ones remained; it was only in 1942 with regard to the selection of pig breeds, that the Ministry of Agriculture and Forests instructed a commission to set the standard of the breed and began considering the establishment of a genealogical book, but with the arrival of the war nothing more was done. By contrast, in the late nineteenth century England already had an Almanac containing lists of breeders of each breed of animal that the *Livestock Journal* published annually. The only Italian breeders of the Berkshire breed known were the Marquis Idelfonso Stanga of Crotta d'Adda (Cremona) and Teodoro Benzoni of Gerenzago (Pavia) (Drouard and Oddy, 2016).

Table 2. Pig Imports of pigs (1892-1896)
Tabla 2. Importación de cerdos (1892-1896)

Countries of origin	1892	1893	1894	1895	1896
Austria-Hungary	3.255	18.058	16.532	2.272	234
France	427	11.551	2.704	5	476
Switzerland	289	489	1.262	1.160	1.518
Other countries	-	-	16	16	43
	3.971	30.098	20.514	3.453	2.271

Source/fuente: Il Coltivatore, 1897: 538-539.

Table 3. Pig Exports (1892-1896)
Tabla 3. Exportación de cerdos (1892-1896)

Destination countries	1892	1893	1894	1895	1896
Austria-Hungary	14.683	11.886	8.120	4.411	1.376
France	2.286	-	35	1.592	168
Germany	13.773	5.003	998	80	80
Great Britain	-	229	71	-	66
Switzerland	17.518	10.145	37.964	47.523	41.892
Other countries	202	45	314	111	-
	48.462	27.308	17.502	53.717	43.582

Source/fuente: Il Coltivatore, 1897: 538-539.

Tables 2 and 3 shows that in the five-year period, Italy imported about 60 thousand head of cattle but exported about 190 thousand, namely three times as many. Imports mainly come from the Austro-Hungarian region with a peak in 1893 and same is also true for France but the volume of imports is, however, subject to considerable fluctuations from year to year. In the first year considered (1892), exports are about 48 thousand heads and are almost halved the following year and reduced again in 1894, to then increase considerably, so that 1895 is the year of maximum exports directly to Switzerland.

In 1880, Onorato Cassella gives us the data of the European porcine population: 60 million, of which France represented about 11% and Italy with 4 million (6.7%) (Cassella and Cassella, 1880; Cassella, 1909).

A royal decree of the Ministry of Agriculture dated on January 7th, 1897, prohibited the importation of pigs from Turkey, Cyprus, Egypt, and the United States, as well as prohibiting the importation of salted and smoked pork from all countries except from Austria-Hungary, Germany, Switzerland, France, and the United States (Il Coltivatore, 1897: 59).

With about 6 million pigs, France was the third producing country after Russia and Hungary, with a predominance of Craonese pigs and other minor breeds of local importance. Austria had no significant farms; Serbia, on the other hand, became independent in 1878 with the Berlin Congress and had a flourishing zootechnical industry, while they were farms in Romania and Bulgaria for local consumption. In Hungary, the dominant breed was the Mongolizca, a Turkish or Mongolicz breed which is an indigenous breed of southern Central Europe, very similar to wild boar and the Chinese breed (Cornevin, 1895). Charles Cornevin tells of a large Mongolizca pig farm in Köbanya (Budapest) where in 1869 the first Hungarian Pig Breeders and Greasers Company and Loan Bank with a share capital of 1,260,000 Italian Lira was established. The corporate purpose was to feed and fatten pigs, deal with the sale of animals, anticipate loans on animals up to 1/3 of their value. The company purchased 90,000 square meters of land between the Hungarian Royal Railway and the Buda railway and built 150 pigsties that could hold up to 20,000 pigs and 90-grain stores; a steam mill for breaking corn and barley and even a hotel.

Each pig shed of 900 square meters could hold 250-300 pigs. In the early twentieth century, the company expanded greatly over 500,000 square meters of land and had 100,000 pigs (Barsanti, 2002).

Table 4. Foreign pig production (1903)
Tabla 4. Producción porcina extranjera (1903)

Countries	N. pigs	Density/Kmq	N. pigs/1000 inhab.
England	2.137.857	12,6	112
France	6.096.232	13,5	189
Austria	354.970	9	123
Hungary	9.000.000	30	600
Serbia	1.679.000	34,5	900
Russia	9.242.997	1,9	113
Switzerland	994.917	0,9	120
Portugal	1.051.994	11,3	223
Spain	1.162.676	4,6	137

Source/fuente: Il Coltivatore, 1897: 59.

The pigs were sold at live weight or net weight as established by contract or by private agreement between breeders and butchers (Table 4). In 1904, the maximum price of pigs on the official market was 125 lire/kg according to the official price list for pigs in the Milan market.

The sanitary regulations prescribed that before the sale the pigs were left in quarantine for a period of observation of 6 days to then be examined by the official veterinarian. Pigs that were affected by diseases were slaughtered in the presence of the veterinarian and after branding transported to the soap factory inside the lazaret (Tino, 2016).

The Italian pork chain and the regulatory framework

The search for quality products and the need to satisfy the consumer has led to great changes especially in the livestock sector that represents the start of the meat production chain.

In Italy, the pork meat chain is distributed geographically with the regions of Lombardy, Umbria, Marche and partly Tuscany and Piedmont designated only for breeding, while the breeds chosen genetically and suitable for reproduction are mainly bred in the central regions and the industries dedicated to fattening pigs and slaughtering are concentrated in those regions closest to the outlet markets (Barsanti, 2002).

Between 1861 and 2015, pork meat consumption in Italy was divided into three main regions: North, Central, and Southern parts of the country. Supposedly the consumption of this kind of meat differed between the regions (Neo and Emel, 2018). Historically, northern regions (Lazio, for example) consumed more pork meat rather than beef due to the belief that wealthy people never used to eat a kind of "rural" meat like beef, sheep, goat, etc. But, since World War II the mentality changed, as well as the economy linked to the pork meat. In these cases, Italy became weak in a market that strongly shifted from Rome to other economic centers like New York City in the USA. Therefore, the main competitors were also "old foes" which became "allies" after Italy's access to the EU. By then, Italy had to put their own agricultural market besides other ones like Germany, Spain, Portugal, or other European Countries (Estabrook, 2015). As for the sector of cured meats, in 2014 a decrease was again recorded both for production and consumption, confirming the negative trend over the last three years. Production fell to 1.17 million tons, a decrease of 1.2% compared to 2013; of these almost 149,000 tons were exported, of which about 42% was crude ham (+ 5.7% compared to the previous twelve months). The cured meat sector has a positive trade balance, with exports exceeding imports (about 48,700 t, 32% coming from Germany), both in terms of quantity and economic value (Lucifero and Giorgetti, 2002).

So, we could establish a common link between the development of the pork meat industry in Italy during the first half of the 20th Century, and the output and recession of the sector after the 1970s, due to the main competitors (another EU country, as well as the primary market economy in the world: The United States). Following the Second World War, there was an increase in the consumption of pork and the ISTAT (Italian National Institute of Statistics) data confirm this growing trend: the Italian pig heritage of 3,760 animals in 1955 increased to 9,132 in 1982. Meat production in thousands of quintals also increased from 2,061 in 1951 to almost 8,000 quintals in 1980 and consequently the annual per capita consumption of pork also

increases, from 5.1 kg in 1938 to 20.8 kg in 1980, thanks to the low and affordable price of meat. This rising trend is accompanied by a change in consumer tastes whose preference is for lean pork characterized by greater muscle mass and a minimal part of adipose tissue and which is intended as a fresh product for meals (a phenomenon that was already started a few years ago in other European countries and the USA) (Flandrin and Montanari, 2013; Curto, 1967; Proto, 1984). However, both for Italian breeders and consumers there is still some resistance to lean light pork; the breeders because they fear that the production of fresh pork will not find a market outlet and the consumers because they prefer sausage products and have some qualms about the consumption of fresh pork especially in summer for reasons of hygiene and safety, so the tastes change slowly (Venzi, 1980; Proto, 1984).

In the 1960s, the increase in per capita income led to a rise in the consumption of meat due to its protein intake and especially of pork, which thanks to the start of industrial transformation processes, had moderate prices and satisfactory quality and hygiene. In the decade 1960-1970, the production of pork meats increased by more than 40%, but despite industrialization, it was unable to satisfy demand and Italy had to resort to importing foreign meat (Tino, 2016).

In particular, the continuous search for high quality for the consumer has made it necessary to constantly change breeding techniques, animal feeding, and slaughtering technologies in addition to the interest in breed selection. Of the three types of pigs—heavy, light, and intermediate—the former is very widespread in Italy. The heavy pig supplies fatty meats that are suitable for the curing of sausage products, while in other European countries the focus is on hyper-productive genetics with a greater quantity of lean parts (Neo and Emel, 2018).

The heavy Italian pig, raised above all in the central-northern area of the country, has important economic implications especially for the processing industry: from the cuts of the animal that can exceed 150 kg of weight, precious products, hams, and cured meats are obtained, which for their typical characteristics have received the Protected Designation of Origin status and are recognized internationally as PDO products according to the EC Regulation 2081 of 1992 (Delgado *et al.*, 2002).

Traditional Italian pig farming is based on breeding Large White, Landrace, and Duroc breeds, selected for our typical produce. This product has an important market segment and the Italian chain, controlled and certified to protect consumers, favors higher profitability of the farms due to lower production costs. However, Italian breeders face recurring crises due to the increase in consumption of fresh pork from abroad and because in the processing industry it is the PDO ham that manages to cover production costs. The light pig is an animal bred with particular rationed feeding and in certain micro-environmental conditions and it is always hybrid breeds that reach a maximum weight of 110 kg (Capatti and Montanari, 1999). The problem for the breeder is to follow a particular production standard for this type of pig called "lean" which has not yet been clarified. Indeed, breeders recognize a product category in lean pork that does not consider the breed but follows a certain diet and a type of breeding, which does not yield much fat and is slaughtered depending on the age and weight reached. For this reason, Italian breeders often follow the "double track" strategy, which means that the farmer decides, based on market forecasts, whether to continue the feeding cycle to obtain fat or lean pig.

For greater competitiveness and a good price/quality ratio, an intermediate pig is being evaluated/considered that could be fed with specific feed mixtures and whose meat could replace the import of fresh pork, but could also be used for non-DOP hams with an outlet in the low-price markets.

Regarding the legislation in this sector, in terms of public hygiene, there were the municipal police regulations that forbade the animal's exhibition on public roads, fairs, and markets for private sales or the public auction of animals suffering from contagious diseases; for the buying and selling, instead, the regulations of the June 25th, 1865, decree on the trade-in animals (articles 1498-1506) regulated the sale of animals with hidden defects or faults; the contracts could also be stipulated "for fair use", "halter", that is to say with payment on delivery and "on the line", that is without any guarantee.

Even today, the regulations for slaughtering animals including pigs are based on the provisions of the Royal Decree of December 20th, 1928, n. 3298 as regards the health supervision of Italian meat. Directive 120 of December 20th, 2008, regulates the production of pigs; it repeals directive 91/630/EEC and gathers in a Consolidated Act all the other regulations already in force that apply to all categories of breeding and fattening pigs, to piglets, piglets, fattening pigs, sows, gilts, boars and so on (Rastoin and Ghersi, 2010).

At a national level, there currently is the *Manual of Correct Operational Practice for Pig Farms* which sets out the operational methods to guarantee food safety and traceability of pork by EC Reg. 178/02, 852/04, and 853/04 as well as food purchased or produced, administered to animals according to Reg. CE 183/05 and in compliance with Legislative Decree 193/06 and Legislative Decree 158/06 for pharmacy surveillance. Other current legislative references in Italy are Legislative Decree December 30th, 1992, n. 534; Implementation of directive 91/630/CEE, which establishes the minimum standards for the protection of pigs, published in the *Official Journal* of January 11th, 1993, n. 7 and amended by Legislative Decree February 20th, 2004, n. 53, implementation of directive n. 2001/93/CE which establishes the minimum standards for the protection of pigs, published in the G.U. n. 49 of February 28th, 2004, ordinary supplement n. 30. The text also implements Directive 2001/88/EC on the same subject; the Legislative Decree October 26th, 2010, n. 200, implementation of directive 2008/71/EC on the identification and registration of pigs (G.U. n. 282 of 02/12/2010). Lastly, the Legislative Decree July 7th, 2011, n. 122, implementation of Directive 2008/120/EC, which establishes the minimum standards for the protection of pigs published in the G.U. n. 178 of 08/02/2011 (Saraiva, 2016).

At a community level, the importance of the impact of pig farming on the environment has meant that action should be taken from a legislative point of view and specific policies have been implemented in the sector. 2011 was a year of great changes for Italian pig farming with Legislative Decree n. 122 of July 7th, 2011, implementing Directive 2008/120 of the European Commission. This established the minimum standards for the welfare and health of pigs and the establishment of special "Single National Cuts and Fats and Lard Commissions" and specific rules that also regulate the treatment and disposal of animal carcasses (Malcolmson and Mastoris, 2001). However, pig breeding is governed not only by Italian law but also by European Community rules that guarantee the traceability, healthiness, safety, and hygiene of production,

as well as animal welfare, both on the farm and during transport or slaughter, as well as the environmental sustainability of the production activity.

Breeding conditions the environment and causes problems such as nitrogen pollution in water and air (CCIAA Reggio Emilia, 1971). To monitor these issues, in 2007, the Governing Council of the Association for Science and Animal Production (ASPA) set up a study commission on "Monitoring the Environmental Impact of Animal Husbandry" (Kiple and Ornelas, 2000). Among the environmental effects with a negative impact on the environment is the animal wastewater on land and in water, water consumption, the emission of methane and other gases dispersed in the environment. Sustainable animal husbandry that respects the characteristics of farm animals has become a priority not only in Europe but also and above all the indispensable tool to strengthen the relationship of trust between the consumer and the producer (Cassano, 1965; Cassano, 1977; Cupo, 1977; Giannone, 2002).

Manure and livestock manure are common problems for all types of breeding. Nonetheless, they could also represent an opportunity for farmers, as well as a resource for agriculture through proper management that involves the transformation of waste material into agricultural fertilizer. Naturally, this type of treatment plant, given the burden of the initial investments, can only be achieved in the largest and most modern companies (Tino, 2016). The project has been started in some Lombard and Piedmontese companies where the sewage is immediately transformed into dry fertilizer or the fermentation of fecal waste and natural biogas is obtained by a bioreactor, useful for supplying energy at no cost to the plant. In recent years, in addition to the storage and spreading operations of the waste materials, a three-year project called "Denitren" has been developed to eliminate the drawbacks of farm manure, which provides for the active use of microalgae that allow transforming light into energy chemistry. This system works with high-cost systems so that installation takes place on demand: the future industrialization of closed systems for the cultivation of microalgae will allow reducing investment costs and consequently the unit costs of treatment of livestock manure inside the farm. So, the biogas could represent a great opportunity for livestock farms and also offer great advantages for zootechnics in terms of energy production for the environmental (Anderson, 2019).

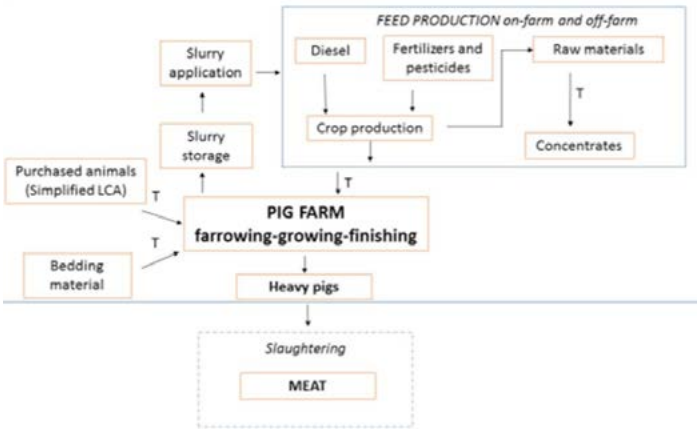
Conclusions

The Italian swine business has been industrializing rapidly in the first decade of this century. While 83.3% of the country's pig farms disappeared, the total number of pigs in Italy grew by 8.5% and the average number of pigs per farm grew by over 500%. Due to this, the Italian Agricultural Census pointed out that in the year 2000, Italy counted 156,818 pig farms, while ten years later, only 26,197 were left-mainly located in the island of Sardinia (4,860), and the regions Lombardy and Calabria. In Lombardy, 100-150 km south of Milan, in the North, 2,642 farms were left in 2010; in Calabria, in the far south of Italy, 2,193 farms were counted. There is much variety among the Italian cold cuts and each of the products has its special features which distinguish it from the others. But all are characterized by common factors which are attributable to the quality of the raw material taken from the pork of the "heavy type".

The production techniques themselves represent crucial factors within the production chain of the cold cuts. Last but not least of the attributes of Italian deli meats is the system of control which is applied to guarantee quality and safety. These controls start already during the phase of livestock breeding, where it is fundamental that the animals get enough space to allow them to move. Hygienic standards are very high and strict controls are conducted both in terms of sanitary and veterinary measures. Numerous controls—especially in hygiene management along the entire production chain until the transport to the selling points, enabled the producers to reduce the quantities of salt used for the preservation of the meats.

The production of PDO (Protected Designation of Origin) and PGI (Protected Geographical Indication) products for example is characterized by the so-called "soft" technologies which employ long-term treatments at a low intensity, emphasizing the high-quality characteristics of the meats. Moreover, the production of food involves an environmental cost and the problem of sustainability in the livestock sector is deeply felt. Changing the diet, for example, less meat consumption could represent a way that could increase sustainability in the production and consumption of food. An updated bibliography reaches us on the methods of sustainability and recent LCA studies (Life Cycle Assessment) (Sala *et al.*, 2017). In fact, relevant is the research done on intensive pig farms in Northern Italy considered mixed farming-livestock systems: in Italian pig farms, the production of heavy pigs has a higher environmental impact than that of light pigs due to the feed used because, in Italy, the DOP regulation for the production of ham imposes restrictive limits on protein feeds. Therefore, for a lower environmental impact, it is necessary to optimize nutrition without increasing the protein intake so the large farms have a lower impact on the environment (Bava *et al.*, 2017) (Figure 1).

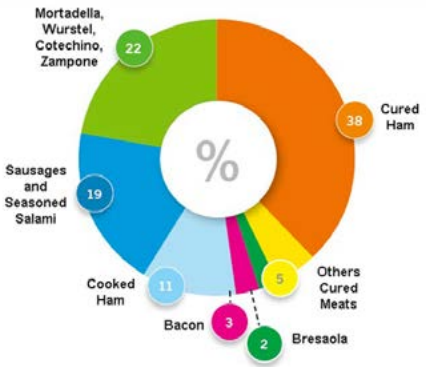
Figure 1. Pig production sustainability
Figura 1. Sostenibilidad de la producción porcina



Source/fuente: Bava *et al.*, 2017.

As we can see in Graphic 1, the Italian pork industry in the lasts years met all standards related to sustainability.

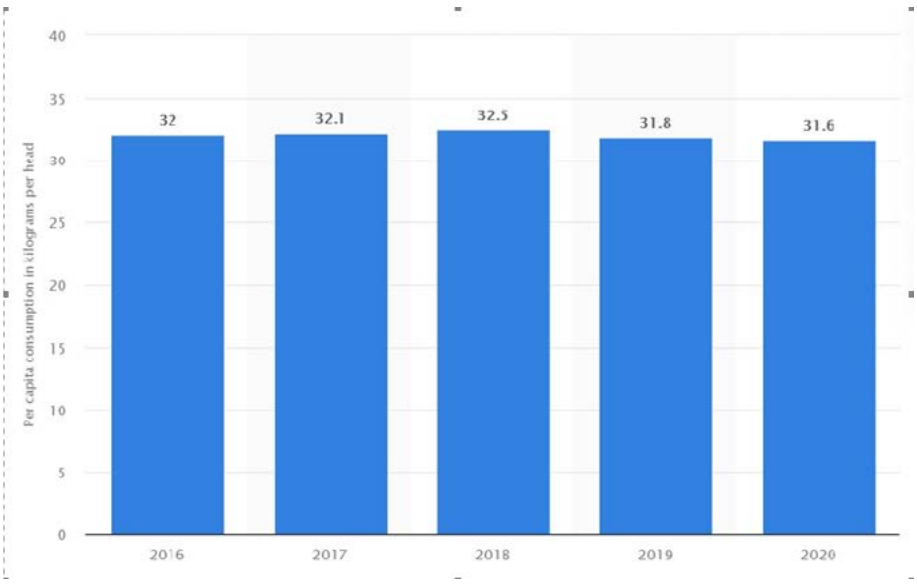
Graphic 1. Italian salumi exports (quantity), in 2019
Gráfico 1. Exportación de salame italiano (cantidad), en 2019



Source/fuente: ASSICA (Industrial Association of Meats and Cured Meats) on ISTAT Data.

Likewise, Italy has fully complied with the orders of the European Commission, for the development of sustainable pig farming, since 2015. We already used some data from official sources for comparison, but it is not necessary to add it as well, due to all of them it is in these graphics, actually (Graphic 2).

Graphic 2. Pro capita pork meat consumption (kg/head) 2016-2020
Gráfico 2. Consumo de cerdo percápita (kg/cabeza) 2016-2020



Source/fuente: Annual Beef Meat Per Capita Consumption in Italy 2016-2020, Statista Research Department.

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