The early development of agricultural engineering disciplines in Italy

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Abstract

This paper illustrates the sequence of events that led to the initial development of agricultural engineering disciplines in Italy. It describes the processes that enabled Italian rural development, as well as the establishment and growth of the number of agricultural higher education institutions prior to their transformation into university agricultural faculties. Finally, the establishment in Europe of the Commission Internationale de Génie Rural (CIGR) and in Italy of the Italian Association of Agricultural Engineering (AIIA) is recalled, which both supported the development of the agri-food sector in Italy.

Introduction

Beginning in the eighteenth century, novel scientific discoveries, particularly in the domains of Physics, Chemistry, Mathematics, and Biology, contributed to the emergence of an innovative, increasingly productive agriculture, fostered by advancements in trade and the establishment of industries for processing farm produce. This novel agricultural approach increasingly drew upon the technological advances made by construction, mechanical, hydraulic, chemical, electrical, electronic, and communication engineering. These applications were initially referred to as "Génie Rural" and later as "Agricultural Engineering". Technological innovations in this field have radically changed the socio-economic basis of agricultural practices, leading to a gradual transition from a fragmented, labor-intensive activity to one that is increasingly mechanized and conducted over extensive areas with limited reliance on human and animal resources. The field of Agricultural Engineering has contributed significantly to the development of modern agriculture, considerably expanding the range of viable productive agricultural arrangements, and paving the way for substantial social achievements and tangible benefits for rural communities. Additionally, significant advancements have been witnessed in the realm of agricultural processing, storage, and marketing facilities, which have undergone a systematic transformation towards increasingly rational operational frameworks.

In this context, conventional Agricultural Engineering is undergoing internationally a transformation towards the broader field of Biosystems Engineering, which extends the applications of engineering also to the natural and biological sciences. This evolution is driven by the need for sustainable development of cultivation techniques, the food sector, land control, and the exploitation of land, water, and environmental resources. As a result of this development, which is constantly evolving and is expected to serve as a guide for the coming years, several international thematic networks have been established to promote the transition from Agricultural Engineering to Biosystems Engineering, to improve the compatibility of new degree programs, to promote their recognition and accreditation, and to provide a platform for the exchange of experiences. Many leading international societies in the field have also added references to biosystems in their titles. Based on such trends, recent research in the field encompasses a range of topics, including precision agriculture, automation of agricultural machinery, use of remote sensors to control large areas, biosensors, nanotechnology, sustainable management of soil and water resources, renewable energy, biosystems modeling, transport of water and pollutants in soil, food security, and decision support systems for the management of agricultural systems (Santini, 2015c).

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Early developments in the mechanization of agriculture in Italy

In the eighteenth century, tools were improved to facilitate fieldwork, and the first innovative mechanisms and tools were introduced to make cultivation techniques more effective. In England, Jethro Tull proposed a rational planting machine and then a horse-drawn hoe to contain the development of weeds (Santini, 2015d). In this period, several mechanisms and devices were also devised, but were not widely used and remained in the state of prototypes. However, some of these devices, conceived by innovative precursors, were later adopted in fundamental agricultural machines due to their functionality. It was not until the nine-

teenth century that a considerable number of scientists directed their attention toward agricultural machinery and equipment (Reitlechner, 1869).

The issue of plowing was addressed by most, and the wooden parts of the plow (Figure 1) were gradually replaced by cast iron and steel elements, designed and manufactured with engineering criteria, leaving the field of craft empiricism. The integration of numerous small, often unidentified innovations resulted in the industrial production and distribution of a wide range of plow models under the name of the patent holder. The introduction of functional seeders, mowers, ginners, reapers, and threshers (Wüst, 1882) contributed to the rationalization and reduction of the harshness of agricultural labor, both for humans and animals. In the United States, the development and marketing of the first horse- or mule-drawn combine harvesters occurred at the end of the nineteenth century (Santini, 2015d).

Steam engines, which were too cumbersome to maneuver in cultivated fields, were used profitably, especially for fixed-point threshing. However, the use of a wheeled tractor propelled by a steam engine had already been employed in artillery in France since the late eighteenth century. The initial advancements in steam technology for agricultural plowing emerged in England during the nineteenth century, with the idea of pulling equipment with a cable driven by a stationary locomotive. Beginning in the 1830s, proposals for effectively viable and cost-effective solutions to steam plowing were developed by John Fowler of Leeds, who initially employed a locomotive on one side of the field to drive a cable, which dragged tillage implements, driven by pulleys and wagons still positioned at the edges of the field (Figure 2). Fowler's proposed system was enthusiastically received in the English countryside and praised with the appellation "*Fowler is very strong*". Over time, the system underwent gradual refinement through the integration of two steam-powered units. Later, brothers James and Frederick Howard of Bedford advanced their steam plowing system, designated "*Round-about*", an appellation derived from the mechanism's capacity to encircle the field to be cultivated. The locomotive they had researched, the Farmer's Engine, was used as the engine (Figure 3), which could also be used for other farm activities (Milone, 1896). By the end of the 19th century, Italian funicular systems were also proposed, linked to the names of Selmi-Zangirolami (1877) and especially Ferretti-Fioruzzi (1884), who built several devices, including plowshares, in his workshop in Piacenza, which he tested in the compact and resistant soils of the Piacenza area. Nevertheless, the

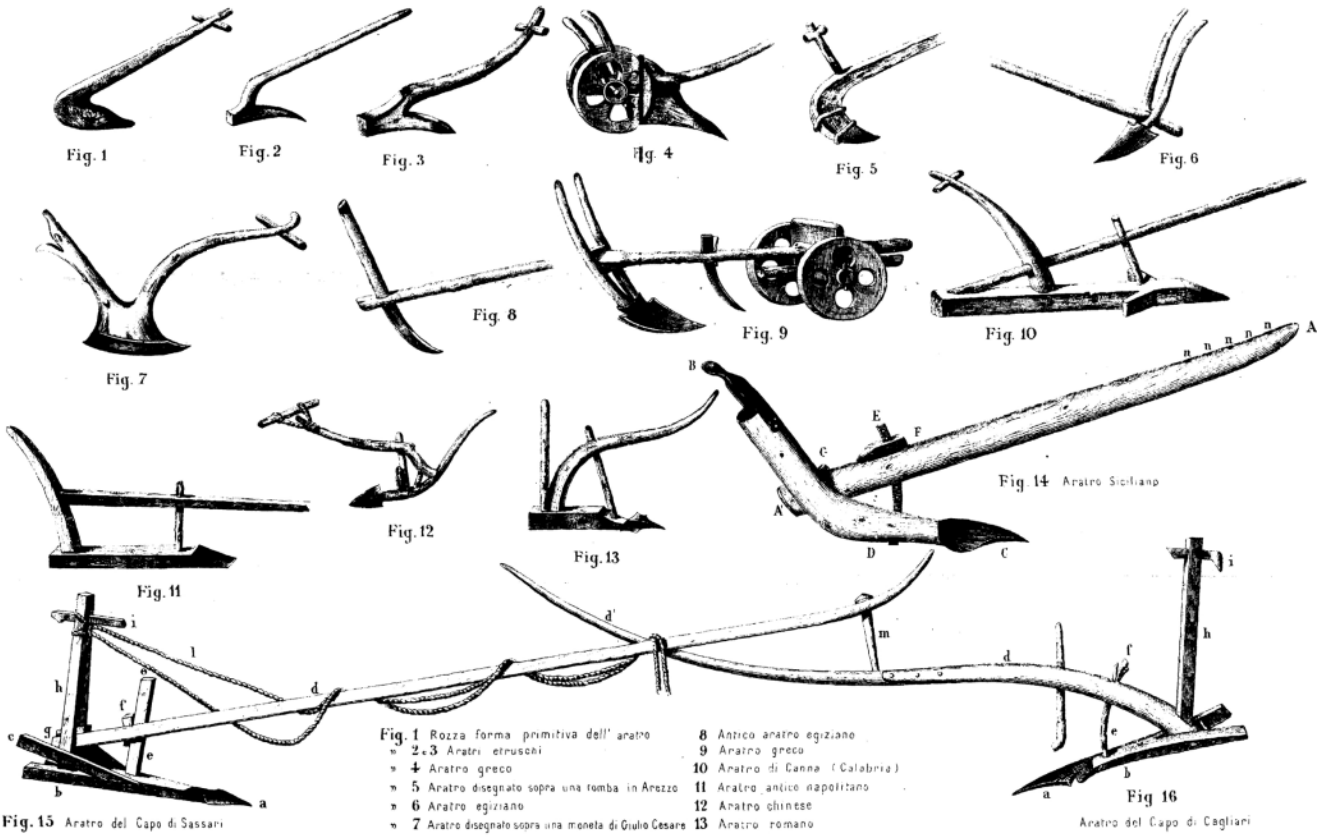


Figure 1. Ancient Plows. Fig. 1.1: A primitive form of the plow from an ancient coin from Syracuse. Fig. 1.2 and 1.3: Plows reproduced from depictions in Etruscan tombs. Fig. 1.4: A Greek plow. Fig. 1.5: A plow drawn on an ancient tomb in Arezzo. Fig. 1.6: An Egyptian plow. Fig. 1.7: A plow drawn on a coin of Julius Caesar. Fig. 1.8: A primitive Egyptian plow. Fig. 1.9: Greek plow equipped with a plowshare and cart, reproduced from depictions in Greek monuments. Fig. 1.10: Plow from the Kingdom of Naples in Canna, Calabria. Fig. 1.11: Neapolitan plow. Fig. 1.12: Chinese plow. Fig. 1.13: Plow from the area around ancient Rome, widespread in Mediterranean countries. Fig. 1.14: Sicilian plow. Fig. 1.15: Plow from Capo di Sassari. Fig. 1.16: Plow from Capo di Cagliari (MAIC, 1882, Table II, pp. 2–7).

diffusion of these early Italian systems was minimal, and their study was primarily constrained to techno-economic aspects (Santini, 1939).

The issue of implementing steam plowing in Italy also garnered the attention of the Ministry of Agriculture, Industries, and Commerce in the late 19th century. This led to the commencement of experiments with the Howard steam funicular equipment in the Roman Agro. After this initiative, a series of trials involving both the Fowler and Italian systems were conducted in the Province of Ferrara. The Farmers' Consortium of Rome conducted plowing trials in 1879, with the participation of its advisors, utilizing a direct-drive steam system proposed by Pietro Ceresa-Costa of Piacenza. This plowing system, which was utilized for direct plow pulling, involved a locomotive that had been previously employed for pulling cannons and military wagons (Figure 4). At the invitation of Ceresa, the dynamic equilibrium of the system was studied by Giovanni Morosini, who applied ground gripping devices (*armillae*) to the front driving wheels to prevent lateral displacement during the advancement of the locomotive. Morosini also observed the locomotive's deficient traction capacity concerning its weight and recommended the application of "*armillae"* to the driving wheels as well to increase grip. These measures would subsequently be adopted in all metal-wheeled agricultural tractors. However, Morosini's studies were not followed by others in Italy mainly because Ceresa's system found little application, and in 1887 statistics recorded the use of only 37 in operation (Morosini, 1882; Santini, 1939) The Ministry of Agriculture, Industry, and Commerce (MAIC), which considered agricultural machinery to be indispensable in Italy for the development of modern agriculture, set up several government depots from 1870 onwards, which found a place in schools of different levels and became not only an educational tool for students but also a point of reference for farmers in the area, who could borrow machinery to try it out. It also allocated grants to various agricultural committees to carry out useful experiments in their respective areas and to collect data on agricultural machinery (MAIC, 1882). The results of the experiments carried out did not solve the problem of identifying the most efficient plowing systems for different field situations, so the same Ministry took the initiative to hold an international competition of steam plows at the National General Exhibition in Turin in 1884, to determine which system was the most convenient (Santini, 2015d; MAIC, 1885).

The first higher education system for agriculture in Italy

After the Unification of Italy, the Ministry of Agriculture, Industry, and Commerce (MAIC) was entrusted with the teaching of topics pertaining to agriculture, which were clearly distinguished from those intended to cultivate the competencies necessary for engaging in autonomous activities. Consequently, a delineation of competencies was established between the MAIC and the Ministry of Education, a dynamic that would persist for many decades. This period was characterized by intermittent periods of collaboration between the two ministries, interspersed with periods of pronounced discord, ultimately culminating in the transition of all higher education, including agricultural disciplines, into the domain of the universities. It is worth noting that the debates on whether to assign the MAIC or the Ministry of Education and the conflicts between polytechnic or university solutions took place, with profound differences, in all the more advanced European states. In Italy, in particular, the agricultural colleges were placed under the jurisdiction of the MAIC to foster a nationwide professional culture that integrated theoretical and practical knowledge. This culture was intended to disseminate knowledge essential for economic development and to establish specialized centers for research and technical assistance to farmers, a practice that had been gaining ground in much of Europe for some time. However, the issue of agricultural education played a significant role in the establishment of the new Italian State during a period marked by ideological and social upheaval. It was believed that legislative interventions in this domain directly influenced the social arrangements of the countryside, thereby creating or penalizing new eco-

Figure 2. Fowler plowing system, complete with locomotive and anchor wagon (MAIC, 1885, p. 24).

nomic and professional structures (Santini, 2015a). Two issues most vividly animated the debates on higher agricultural education: firstly, whether it should adopt a more predominantly practical and experimental approach or have a more theoretical and formative character; secondly, whether it would be more advantageous to maintain its autonomy or integrate it into university studies. The Italian government's decision to establish Higher Schools of Agriculture was mainly driven by the growing interest in modernizing agriculture. This initiative was accompanied by informal interactions between central officials and local notables and administrators, who were tasked with considering projects or actions related to this objective. The forestry sector was the first to see the establishment of a Higher School, though it was initially intended to be kept separate from agriculture. Vallombrosa, located near Florence, was selected for this initiative, with the Abbey becoming available for this purpose. In 1869, a permanent school was established at full state expense, with the objective of training personnel to enter the forestry career. The process of establishing higher educational institutions specializing in agriculture was met with far greater difficulties. This was partly because, before the unification of Italy (1866), the University of Pisa already had an agriculture program. The program was established within the university and had initially been directed by Cosimo Ridolfi. Ridolfi was the founder (1835) of the model experimental farm at Meleto, in Val d'Elsa. This experimental farm was a highly valuable practical higher school of agriculture (Benvenuti *et al*., 1991). Therefore, establishing additional higher educational institutions specializing in agriculture was an arduous task. After the Unification of Italy, the first colleges of agriculture were established in Milan and Portici, initially largely funded by local authorities. The strong will and the persistent pressure exerted by the MAIC for their establishment are well documented (Bidolli and Soldani, 2001), but there was a constant reluctance from local advisory bodies and their most influential representatives to finance institutions that, albeit in the field of agriculture, were aimed at training professors, scientists, and higher officers who were considered far removed from local interests.

The first "*Regia Scuola Superiore d'Agricoltura"* was established in Milan by Royal Decree No. 5633 of April 10, 1870, and by an agreement between the Government, the Province, and the Municipality, on the initiative of the Agricultural Society of Lombardy and with the generous contribution of the local authorities and a group of entrepreneurs who, in those years, promoted the foundation of the Polytechnic in that city and with which the Higher School of Agriculture subsequently maintained close relations for a long time. This Milan Higher School, waiting to be moved to the premises of the former Convent of the Incoronata at Porta Garibaldi, was initially housed in the vast building known as S. Luca near the former Porta S. Celso, which had previously been used as the seat of the Military College. The

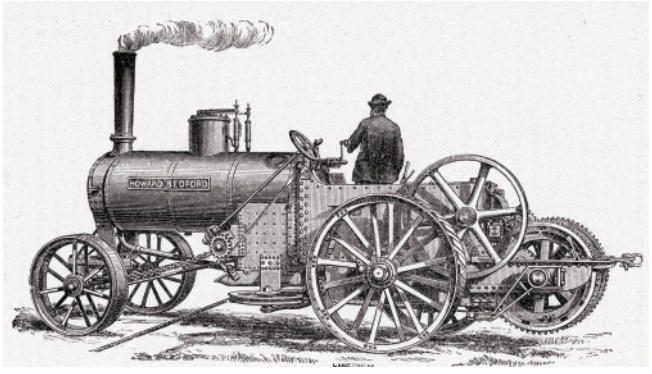


Figure 3. The Howard locomotive, also known as the "Farmer's Engine" (MAIC, 1885, p. 41).

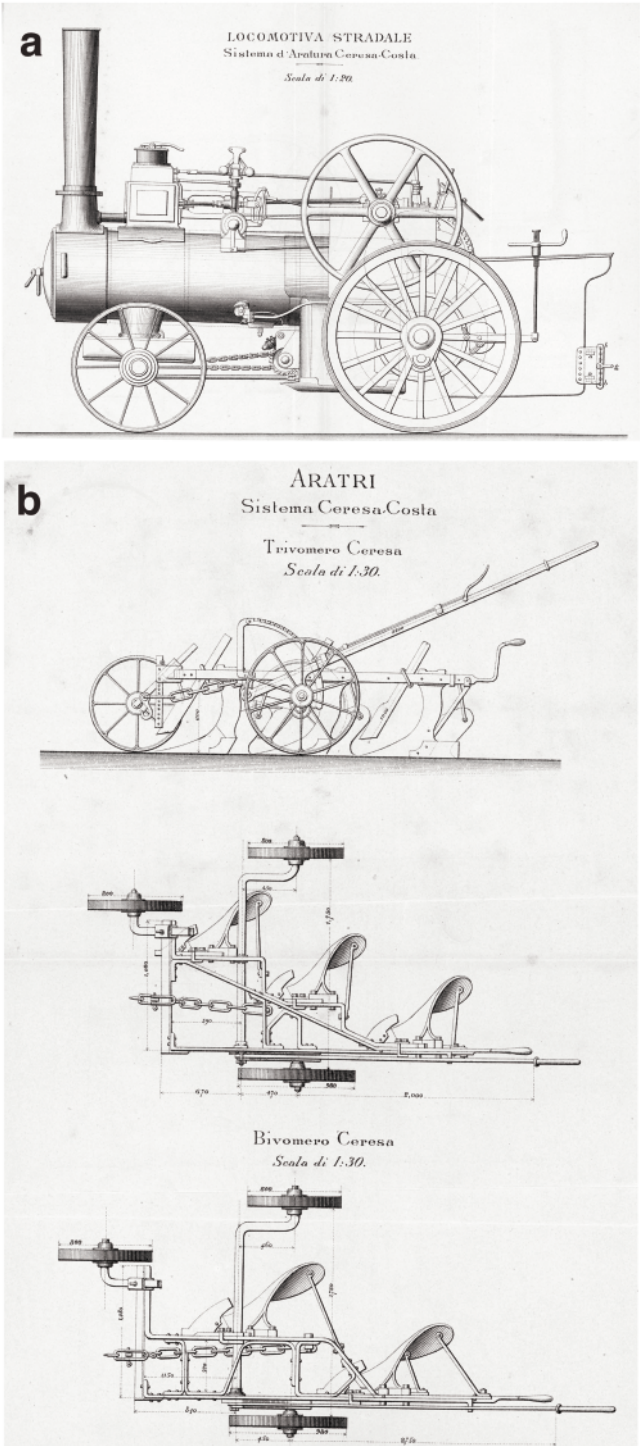


Figure 4. The Ceresa-Costa Plowing System: a) locomotive; b) plows (MAIC, 1885, Tables III and IV).

courses began in 1871, after the enactment of the implementing regulations, under the direction of Gaetano Cantoni, and to relieve agriculture from the state it was in through the transfer of scientific knowledge to the reality of agriculture and industries of processing of farm produce (Regia Scuola Superiore d'Agricoltura in Milano 1922, 1923).

The idea of establishing a Higher School of Agriculture in Portici was first put forward by Carlo Ohlsen, a prolific and versatile writer on agriculture who, in 1865, sent a report to the Province of Naples Council in which he invited the Provincial Council to purchase for this purpose the Bourbon Palace of Portici and the adjoining park. These premises, divided into lots, had been put up for sale by the State Property Office through a specially created company (Ohlsen 1865; Santini A 2021, pp. 191-194). Only in 1872, with the decree of January 14, no. 658, was the "*Regia Scuola Superiore di Agricoltura*" established at the Royal Palace of Portici, which was transferred to the Province of Naples under Law No. 337 of July 31, 1971. Its statute was approved with the following purposes "*to carry out and perfect the secondary agronomic education spent in the technical institutes and special schools; to instruct with special training those who intend to become professors of agricultural sciences; to promote the progress of agriculture through experimental research*" (Santini, 2015a).

The two higher schools in Milan and Portici initially enjoyed considerable autonomy but were placed under the control of the MAIC, which also supported them with funding. The courses lasted three years and were open to students from high schools or technical schools, or those who had passed an entrance exam. From the beginning, the teaching of agricultural engineering subjects was included. In Milan, the teaching of Advanced Physics and Agricultural Mechanics was initially supervised by Giovanni Morosini, who had worked at the Agricultural Institute of "*Corte del Palasio*", previously founded by private initiative in the Lodi area, and who was appreciated for his modesty as well as his scientific preparation. In Portici, the first Chair of Agricultural Mechanics and Rural Construction was given (1875) by selection to Francesco Milone, Professor of Machinery at the Royal Engineering School in Naples (Russo ,1967; Silvestri, 1928).

The trajectory of the Higher Schools of Milan and Portici was marked by the suppression of the MAIC in December 1877 and their transfer to the Ministry of Public Education. At that point, a considerable portion of the regulations, programs, and organizational framework for these institutions had already been established before the transfer. The subsequent strong protests compelled the politicians to swiftly reinstate the MAIC under Law No. 4449 of June 30, 1878, which redefined its attributions. However, agricultural higher education did not return to the MAIC's jurisdiction until 1885, after overcoming the opposition of the Ministry of Education to cede the two Higher Schools in Milan and Portici. These institutions were regarded as the natural outlet for students from the technical institutes, which were within the MAIC's purview and were assumed as second-rate schools that offered students access to a university education. Those who opposed the return of the schools to the MAIC contended that an economic ministry lacked sufficient "cultural dignity" to oversee the education of the middle and managerial classes. In the end, the prevailing perspective that only technicians could develop an economic sector as important to Italy as agriculture prevailed, and Law No. 3141 of 1885 established the return of the Schools of Agriculture to the MAIC.

In the reconstituted ministry (MAIC), a major reorganization was initiated, functional to a modern economy. A concerted effort was made to establish a novel organization for higher agricultural education, to disseminate what scientific progress and technology were making available for agriculture. In a concerted effort to bolster the nation's economic development, the MAIC established the Directorate of Agriculture, which was initially headed by the minister but later transformed into the General Directorate of Agriculture. New public figures of agricultural and educational inspectors were introduced into the ministerial staff, charged with the tasks of control, investigation, and study. Moreover, MAIC deemed it appropriate to undertake a comparative survey that would encompass the practice in Europe in the field of teaching in agriculture. To this end, a comparative analysis was conducted of the systems and organization of 23 European Higher Schools of Agricultural Interest, both autonomous and university-based, which operated in Germany, England, Belgium, Austria-Hungary, and France. The survey revealed that the Higher Schools of Milan and Portici had adopted a resolution to prioritize the expansion and strengthening of the teaching of agricultural, zootechnical, technological, and other disciplines, which for the sake of brevity will be referred collectively to as "rural engineering." This resolution also encompassed the completion of mathematical and general scientific instruction within the schools themselves. The survey also highlighted the paucity of financial and human resources of the secondary schools operating in Italy compared to similar European institutions (Miraglia,1887).

Once the two Higher Schools of Agriculture in Milan and Portici came back under the control of MAIC, a competitive recruitment system was introduced for the teachers, who were permanently employed as state employees, so as to limit their flight to more secure jobs. The Portici Higher School, now fully supported by the State, was run by a Board of Teachers headed by a director, who thus became the interlocutor with the MAIC. The Milan Higher School, instead, continued to be funded by the city and province and was part of the local Consortium of Educational Institutes. For both higher schools, however, new regulations were issued. In Milan, the regulations were approved in 1888 (by Royal Decree No. 5783 of Nov. 1), while in Portici they were approved in 1889 (by Royal Decree No. 6253 of June 30). With the advent of these new regulations, the duration of the courses was increased to four years and new lectures were introduced both in the basic and in the characterizing disciplines, a development also favored by the business world.

Nevertheless, the awarding of qualifying diplomas to educators who had successfully completed an additional two-year master's program persisted. The Directors of the College of Agriculture were granted the prerogatives of rectors and deans of universities. It was further noted that, due to the increasing importance of reclamation and irrigation works, the teaching of hydraulics for agriculture should be introduced (Santini, 2022). The new legislation introduced a change in the level of qualification, which became that of graduate agronomists, which was a cause of strong controversy. This issue was resolved with the re-establishment of the title of Master of Agricultural Sciences in 1892 (Bidolli and Soldani, 2001; Fileni, 1956).

The advancement of agricultural sciences in Italy was undoubtedly the result of a remarkable action of the MAIC, which operated with meager resources but with cleverness and commitment to support numerous and important initiatives. Nicola Miraglia (1835-1928), who served as Director of Agriculture and subsequently as Director General of the Ministry, for 30 years played a pivotal role in shaping the Ministry's policy that favored the education of both farm-hands and landowners to achieve agricultural progress without disrupting the existing

difficult economic and social relations in the rural world. Miraglia was the main promoter of all MAIC initiatives, as evidenced by the numerous documents preserved in the MAIC archives (Bidolli and Soldani, 2001). His authoritative and indefatigable personality is evident from several documents written in his hand or personally revised and corrected, and from his correspondence with citizens who submitted proposals, requests, or pointed out problems to be solved.

The "*Istituto Sperimentale di Perugia*" was established by Royal Decree on August 9, 1896, with the primary objective of educating the children of landowners and tenants of rural property about life in the fields, as well as providing them with scientific instruction, but with demonstrations, experiments, and individual work in laboratories and fields. The inauguration of the Institute occurred on November 25, 1896, in the presence of the MAIC Minister Francesco Guicciardini. The Institute commenced operations with its initial cadre of teachers as a result of a nine-year agreement signed between the MAIC and the local University. The Institute's organizational structure was initially divided into two sections: the first was located on the premises of the old Benedictine Abbey of St Peter, which belonged to the Agricultural Foundation of Perugia, whereas the second was located in the large Casilina estate, which encompassed more than 1,500 hectares and was divided into 51 farms. The courses lasted four years and were split into three periods: the initial period consisted of an annual introductory course, comprising lectures in legal sciences, natural sciences, and experimental sciences; the second period lasted two years and included lectures in applied agricultural sciences, whereas the third was an annual professional practice, during which the student resided in the Casilina estate. The organization of the third period was entrusted to a professor who also served as director of the rural estate. The students were assigned to a business branch, where they operated freely under the director's guidance, taking responsibility for their actions. By decree on July 14, 1899, the Perugia Institute was authorized to confer the degree of agricultural science and the doctoral degree. The Institute's legal representation and educational coordination were initially entrusted to Senator Eugenio Farina, who had been strongly involved in establishing the institution. After this development, new regulations were issued on February 11, 1904. These regulations introduced the position of President with legal representation, thereby transferring the educational coordination to the Director, and, with the first article, changing the new name to "*Regio Istituto Superiore Agrario Sperimentale di Perugia*" (Stringher, 1900; Università di Perugia, 1996).

Subsequently, the university structure was strengthened with the start of the courses (academic year 1901-1902) of "*Scuola Agraria Universitaria di Bologna*", developed under the Ministry of Education as an ideal continuation of the university chair in agriculture initially held by Filippo Re. This institution was strongly desired by the local "Cassa di Risparmio" (Savings Bank) of Bologna to provide benefits for the development not only of agriculture in Emilia but also in the entire nation. The school was financed exclusively by the Savings Bank and had a temporary character and a duration of ten years. The reason for this was that the State wanted to protect itself from any future obligation to continue in case the funding of the promoting institution ceased. Many experts were invited to collaborate on the initiative, including Ghino Valenti, Domizio Cavazza, and Cesare Zucchini. The project took shape on May 16, 1900, with the signing of a cooperation agreement between the University of Bologna and the Savings Bank, which was followed, after laborious negotiations, with parliamentarians and the Ministry of Education, by Law No. 289 of June 9, 1901, which established the University and also defined its statutes. Upon completion of a four-year program, students gained the title of Master in Agricultural Science. Francesco Cavani, who was a professor of Topography and Practical Geometry and came from the "*Scuola d'Applicazione per Ingegneri*" (Engineering School), held the position of director of the School. According to the statutes, the Higher School consisted almost exclusively of faculty members who were members of other colleges or schools. The specific agricultural subjects were entrusted to four professors from outside the University of Bologna: Domizio Cavazza for horticulture, fruit-growing, and enology; Vittorio Peglion for biology; Jacopo Ravà for the economics of agricultural enterprises and rural accounting, as well as dairy; and Francesco Todaro for agriculture. Later, the school assigned Ciro Ravenna the course in Agricultural Chemistry and Dino Zucchini the course in Rural Construction and Agricultural Hydraulics. While waiting for the renovation of the Viola building, which was planned to serve as the school's headquarters, the premises for carrying out the activities were identified in the nearby "Bianconcini" Palace of Fine Arts. At the end of the ten-year experimental period of the School, given the encouraging results achieved, a new convention was approved by Law No. 335 of April 9, 1911, which established its definitive transfer to the State (Casini-Ropa, 2000; Baraldi and Segrè, 2011; Casadei, 2022).

In the early twentieth century, despite significant challenges, the Italian State had managed to provide itself with higher agricultural education facilities. Vittorio Stringher, an MAIC librarian, noted that: "*Italy has no institution that can compare with the National Agronomic Institute in Paris, the R. Higher School of Agriculture in Berlin, the R. Higher School of Agriculture in Vienna, the Petrowskoi Academy in Petersburg; [...] only for some years [the Higher Schools of Agriculture in Italy have taken] an arrangement of their own and are proceeding without that uncertainty which for the past returned to be of grave harm. [...] The public now surrounds them with greater confidence and the number of pupils who attend them, grows every year with remarkable progression*" (Stringher,1900). Italo Giglioli, in his capacity as a juror at the 1900 Paris World Fair, also noted the following: "*in the three main autonomous agricultural schools of Germany there was an increasing tendency to create agriculture professionals, with a high degree of mathematical and scientific knowledge; that is, to train agricultural engineers*". In Italy, these disciplines were not adequately present, although the problems of land reclamation, irrigation, land transformation, rural construction, and mechanization were important for agriculture. In his report, Giglioli also pointed out the lower ranking of students in the Italian Agricultural Higher Schools compared to those in Europe, stating the following: "*If we recall that in Italy the number of students in all agricultural colleges and universities in 1898-99 was 337, we see that in Prussia (with a population almost equal to that of Italy) there are five times as many devoted to agricultural studies as in Italy*" (Giglioli, 1903).

In the early years of the twentieth century, however, a small group of teachers, researchers, and agricultural technicians, trained in higher schools and dedicated to their own or other farms or the new Italian agricultural institutions, began to form. This group played a key role in the modernization of agriculture and was one of the main architects of the rapid progress that occurred in Italy, particularly in the south. Even if a precise calculation of the increase in agricultural production is difficult

due to the lack of reliable data during that period, it is very likely, as Manlio Rossi-Doria argued, that "*agricultural production in southern Italy increased by 30-40 percent in the twenty years between 1895 and the outbreak of the First World War, with rates that closely mirrored those of the rest of Italy*" (Rossi-Doria, 1972).

The development of agricultural mechanization in Italy

In the early years of the 20th century, Italy witnessed a proliferation of tools for soil complementary works, with the introduction of the first machines for sowing and harvesting, as well as those for the wine and olive oil industries. The dissemination of agricultural machinery occurred through various means, including teaching, practical demonstrations, publications, illustrative pamphlets, and expositions. Notably, Agricultural Machinery Competitions played a particularly significant role in this dissemination, as they were directly tied to the establishment of rankings based on empirical testing, resulting in a high degree of effectiveness (Santini, 2015d). During this period, the advent of motor plow machines in the United States, powered by internal combustion engines, coincided with the emergence of locomotives on the market. These machines rapidly proliferated in Europe. In 1907, the Stock Motorpflug Gesellschaft in Berlin built an early motor plow machine carrying three plow bodies on a frame to which a gasoline engine was attached, which was praised for its speed, simplicity, and rational mechanics.

In Italy, the design of motor plow machine was pioneered by engineers Pavesi and Tolotti of Milan, who built a model with three plow bodies on a three-wheel frame and with engines powered by gasoline or petroleum (Figure 5). One of these models was first presented and awarded a prize at the Motor Plow Competition held in Turin in 1911 and was also quite popular in some European nations. However, power tillers were rapidly replaced by tractors, which spread successfully in the United States of America. With the advent of internal combustion engines, they were also introduced in Europe, particularly in France, Germany, and England. In the early years of the twentieth century, several experimental and testing stations for agricultural machinery were established in Italy, modeled after similar institutions in Germany and France (Figure 6). These stations were instrumental in selecting the optimal agricultural machinery and advising farmers on the products best suited to their needs (Giordano,1906).

Before the First World War, however, the use of agricultural machinery in Italy remained limited. In contrast, Germany and the United States of America experienced consistent industrial development of mechanics. The production of tractors, built with criteria of strength and durability, increased significantly. However, these tractors were still too heavy and unwieldy to be used in many environments in Italy. Direct-drive agricultural machinery became widespread in Italy after the Parma (1913) and Vercelli (1914) competitions, where prototypes of Italian design with tracks and metal wheels were exhibited alongside American and German tractors. Concurrently, Italy witnessed the initial implementation of electricity in agriculture for the traction of tillage equipment. The most common arrangement was that of the funicular system, where the steam engine was replaced by an electric one, and light equipment of modest power was also proposed, suitable even for tillage in hilly environments. Later, direct plowing systems with tractors driven by electric motors were experimented with, but the high cost of the equipment, which had to include an electricity distribution network within the farm, high maintenance costs, and low labor productivity, soon made these techniques abandoned. The first operating machines introduced during this period were essentially pulled by cattle or horses, and often ingenious solutions were adopted to enable the movement of working parts by connecting them through transmissions to the load-bearing metal wheels.

It was only after the outbreak of the First World War that further developments and refinements were determined in Italy, dictated by the need to maintain the main agricultural operations in the countryside for the drawing of guns and security, while good men were called to fight. After a year of war, which had passed without any significant results and with no prospect of seeing a cessation of hostilities soon, there was a growing conviction that the State should support the main operations in the fields by employing soldiers of the territorial militia in agricultural work and by promoting a greater spread of agricultural machinery. For this reason, Official Gazette No. 198 of August 22, 1917, approved an agreement between the MAIC and the Ministry of Arms and Munitions for a "*Servizio di Motoaratura di Stato*" (State Motor Carrier Service), entrusting the latter Ministry with the material and machinery to be procured and those it deemed necessary to purchase for the proper performance of the service (a total of about

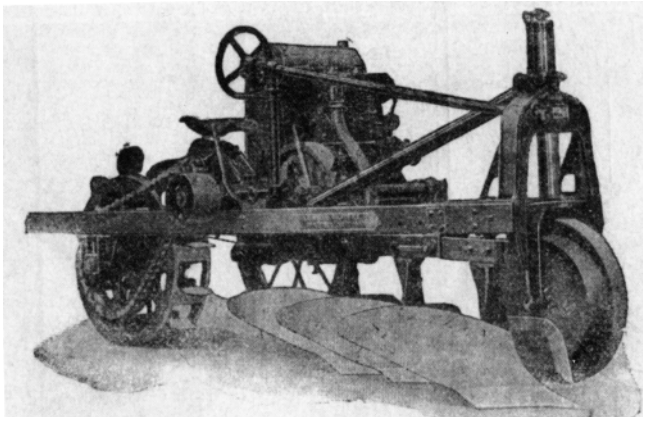


Figure 5. Pavesi-Tolotti motor plow machine. This machine has three plow bodies and an internal combustion engine (12 kW or 30 kW), which was mounted on a three-wheel chassis. It had one drive wheel, one steering wheel, and one load-bearing wheel (Santini, 2015d).

Figure 6. One of the test rooms at the Experimental Station for Agricultural Mechanics in Paris (Giordano, 1906 - fig. 8).

6,000 tractors were imported during the war). In particular, several "Case" tractors were purchased from the United States, which were new in Italy but were considered to be among the most interesting at the time, thanks to the good tests they had passed abroad in many international competitions. As soon as the first ordered machines arrived from abroad, they were assembled by the Federation of Agricultural Consortia and by Cosimini and Giusti company. The "Case" tractors were concentrated in Naples, for which the Ministry of Arms and Munitions directly carried out the assembly and testing with the help of working soldiers. At that time, the burden of operating agricultural tractors was also entrusted to military departments (Mayer, 1919).

After the First World War, however, the number of tractors used in the fields in Italy increased steadily, as a result not only of the "*Servizio di Motoaratura di Sato*", which made the first agricultural machines known and appreciated and gave a glimpse of the new horizons that were to open up for the agricultural possibilities but also of the progress and refinements made by Italian industry, which in this sector was moving from the artisan stage to the production of tractors with internal combustion engines, using industrial processes, which definitively replaced the heavy and cumbersome locomobiles. At the end of the First World War (1915-1918), Pavesi designed the first four-wheel drive tractor. In 1919, Fiat built its first metal-wheeled tractor with a four-cylinder petrol engine; in 1932 Fiat began the mass production of a crawler tractor (the 700 C of 25 kW); in 1927 the Cassani brothers built a tractor with a diesel engine and later (1942) founded the "*Società Accomandita di Motori Endotermici"* (SAME), which was created in general to produce internal combustion engines for civil and industrial use, but later also dedicated itself to the tractor sector.

In the period following the First World War, the lack of skilled workers to operate the newly developed agricultural machinery was a major problem. Consequently, during the Congress of the Italian Farmers' Association in Rome in 1921, a proposal was made to establish a "*Scuola Pratica di Meccanica Agraria"* (Practical School of Agriculs) to train farmers in the use of machinery. By Royal Decree No. 1923 of July 19, 1924, the School was established in Rome's Capannelle and was equipped with substantial agricultural machinery, as well as a boarding school with a capacity of 40 students. The institution was established as an autonomous consortium body, endowed with legal personality under ministerial supervision, with the aim of "*training agricultural mechanics and drivers of agricultural machinery*". The School was endowed with the premises, machinery, vehicles, and other assets that had been left over from the discontinued "*Servizio di Motoaratura di Stato*". However, the demand for education exceeded the capacity of these resources, prompting the establishment of four additional branches in Emilia, Sicily, (Capitanata), and Sardinia (Santini, 2015d).

The enactment of laws on integral reclamation resulted in a resurgence of interest in rural construction, driven by forward-thinking farmers, technicians, and researchers. This initiative aimed to adapt the industry to the evolving demands of agriculture, a process that also encompassed similar interventions in the African colonies recently acquired. This process led rural buildings to increasingly break away from traditional, centuries-old design and construction patterns, accounting also for biological, economic, agronomic, and technical/constructive issues that were so new and complex that the old empiricism could no longer address them. Initially, the renewal process mainly concerned the interiors of rural farm buildings and, in particular, their distributional, dimensional, and equipment characteristics. Later, bearing in mind the climate and the materials available, the various parts of the rural buildings were studied to make them efficient in their purpose and the ordering of production, leading to changes, even profound ones, in the most conspicuous constructive and architectural features. The organization of farm buildings, in the plans for land reclamation and cultivation of vast territories, was increasingly pursued according to criteria of rationality, economy, convenience, and aesthetics in keeping with urban planning (Santini, 2002).

In addition, the period between the two World Wars witnessed important events in the realm of agricultural engineering. In Rome (1932), within the framework of the "Week of Agricultural Mechanics," a First National Congress and an Exhibition of Agricultural Machinery and Tools were held. The inaugural First Italian Congress of Agricultural Mechanics (May 12-14) was held in Julius Caesar Hall on Capitol Hill (Figure 7), in the presence of Minister Giacomo Acerbo and the Undersecretaries of Agriculture Arturo Marescalchi and Arrigo Serpieri. In his address, the Minister emphasized the pivotal role of machinery in reducing costs and intensifying agricultural production. Meanwhile, Carlo Santini edited the printing of the volume of the Proceedings that collected all the material of the reports and discussions (Santini, 1932), which can be grouped into six main topics. The first group includes the papers concerning the problem of tillage illustrated by Emanuele De Cillis, and that of tractors, illustrated by Nerlo Nerli concerning the studies carried out abroad, by Giovanni Vitali, with special attention to sloping soils, and by Carlo Santini on in-situ traction tests. The second and third groups of research concerned irrigation machinery and those related to specific crops, respectively. The fourth group was concerned with investigations into the economic use of agricultural machinery. The various aspects of the use of electricity in agriculture were explored in depth in the reports of the fifth group. Finally, a final group considered the relationship between agricultural mechanics research and national defense, illustrated by Prof. Federigo Giordano and General Pugnani, of the Ministry of War (See: "Agricultural Messenger" of 5/12/1932, A valuable publication. The Proceedings of the Congress of Agricultural Mechanics).

The exhibition of agricultural machinery and equipment, held at the "Parioli" locality (May 8-23, 1932), garnered significant interest and attracted a considerable number of visitors, including King Victor Emmanuel III. According to contemporary reports

Figure 7. Rome, Campidoglio, Sala Giulio Cesare. Inaugural session of the first National Congress of Agricultural Mechanics. Rome, May 12, 1932 (Santini Archive).

(see: "Il Popolo d'Italia" of May 1, 1932, and other contemporary newspapers), the king, accompanied by the authorities, visited the "*great exhibition at length, carefully examining the various departments. The Sovereign was particularly interested in the collection of "machines exhibited in the Fiat pavilion", which were illustrated by Colonel Lambert, at the stand of the R. Istituto Superiore Agrario in Portici, where he was received by Senator De Cillis and Prof. C. Santini. He then visited the pavilion of the Undersecretariat for Integral Land Reclamation and then went on to examine the vast field of irrigation equipment, showing great interest in the large pumps, drills, and the hydraulic cannon that shoots mighty jets of water at a distance of more than 120 meters, [...] On leaving the authorities, H.M. the King expressed to Minister Acerbi and the Honorable Angelini his great satisfaction with the success of this important review of national industry*". In the same year (October 1932), the first National Land Reclamation Exhibition was also inaugurated in Rome, with the contribution of the Consortia and Land Reclamation Companies that were operating in those years in a sector where the Italian government had committed itself with substantial funding and with the realization of major engineering works, not only for the draining of marshy territories but also for relevant hygienic, demographic, economic and social purposes (Santini, 2022).

On the international stage, it is also worth mentioning the first "Congrès International du Génie Rural", which took place in Liège beginning on August 1, 1930 (Exposition Internationale du Centenaire, 1930, Belgium). On August 5, 1930, during the Congress, the "Commission Internationale du Génie Rural" (CIGR) was established in the Academic Hall of the University of Liège with the participation of Italian technicians and administrators working in the realm of agriculture. The mission of the CIGR was summed up in three words: liaison, coordination, and initiative. Four technical sections were identified as areas in which CIGR's interests were focused:

- Section I: Land Reclamation, including agricultural water management (drainage, irrigation, sanitization, embanking), land management, and land clearing;
- Section II: Farm buildings;
- Section III: Mechanics with farm machinery, mechanized farm operation, electricity;
- Section IV: scientific work organization.

In 1935, the II International Congress of CIGR was held in Madrid (Republica Española. Ministerio de Agricultura 1935), and subsequently (Sept. 26, 1935) the CIGR Commission met (Figure 8). The Madrid Congress was attended by collective members from the USA, Italy, Switzerland and Spain, as well as individual members from 14 nations: Germany; Argentina; Belgium; Bulgaria; the USA; France; Great Britain; Italy; Latvia; Poland; Portugal; Switzerland; Czechoslovakia; and Spain. The papers presented were published in the proceedings, divided into four sections: 1st section, soil science, agricultural hydraulics, land management; 2nd section, rural construction; 3rd section, agrarian mechanics, agrarian application of electricity; 4th section, scientific organization of work in agriculture. The III CIGR Congress, which was to be held in Rome, however, could not be organized due to the outbreak of World War II.

The vicissitudes of the Higher Agricultural Schools after the First World War

The period between the two world wars was a time of intense reform in Italy in terms of agricultural research and education. From the first years after the First World War, Francesco Saverio Nitti endeavored to reinvigorate the MAIC's colleges, not only to increase their prestige and authority but also to block the unabated aims of the Ministry of Education to assume control of all agricultural education. A Commission for the Reorganization of the Agricultural Sector, set up by the National Scientific and Technical Committee for the Development of Italian Industry, then emphasized the need to strongly reinvigorate the colleges to better guide the nation's further agricultural progress (see: Central State Archives: Ministry of Public Education, dir. Gen. Higher Education, div. II, 1923-1938, b. 71 fasc. Commission for the Reorganization of Agricultural Colleges).

In its final report, the Commission examined the shortcomings resulting from the following issues: a) the existence of two groups of agricultural colleges, belonging respectively to the MAIC (Milan, Portici. Perugia, and the Forestry Institute in Florence) and the Ministry of Education (Pisa and Bologna), and b) the lack of an organic law governing them all. Several critical issues were also pointed out, including the need to provide agricultural mechanics chairs with workshops and laboratories for machine testing, as well as the need to increase the number of professors and assistants. Some of the proposals of the above committee were accepted by the May 1919 Decree-Laws No. 175 and Aug. 25, 1919, No. 1850, which established better economic treatment for the staff of the colleges, as well as an increase in their endowments. These decrees also expanded the number of professors, assistants, and secretarial

Figure 8. Madrid, Second International Congress of the CGR. Upper panel: some participants at the reception offered by the Spanish Association of Engineers on September 25, 1935. Lower panel: some participants at the CIGR Commission meeting on September 26, 1935, with Carlo Santini in the background on the right (Santini Archive).

staff at the Milan, Portici, and Perugia colleges.

Subsequently, the Alfredo Baccelli, Minister of Public Education in the Nitti government, upon receiving a request from the Director of the Agricultural College of Bologna for the renewal of the regulations of the same school, urged the appointment of a special commission to study "*the best arrangement to be given to the Higher Schools of Agriculture, to respond worthily to the needs of science and agriculture*" of the country. The commission, appointed jointly by the MAIC and the Ministry of Education, began its work in March 1920 and was composed of the directors of the higher schools: Francesco Cavani of Bologna; Angelo Menozzi of Milan; Alessandro Vivenza of Perugia; Italo Giglioli (later replaced by Eugenio Ficalbi) of Pisa; Oreste Bordiga(replaced by Filippo Silvestri) of Portici, and Arrigo Serpieri director of the Higher Forestry Institute of Florence, who had replaced the Vallombrosa Institute in 1912 and was located in the regional capital at Cascine (Surico, 2014; Santini, 2015b).

The Commission initially identified a significant gap in the quality of education between the Bologna and Pisa Higher Schools and those of the MAIC. This discrepancy was attributed to staff shortages and inadequate facilities for teaching and assessment. The Commission strongly recommended that the Ministry of Education address these pressing concerns. Subsequently, the objectives to which agricultural high schools should aspire were established. It was his conviction that the aforementioned objectives were as follows: first, to promote the advancement of agriculture through studies, research, and instruction of teaching staff; second, to train young people in the management of scientific agricultural problems; and third, to prepare young people for professional agricultural practice, including the management of farms and the operation of agricultural service bodies, as well as the appraisal and construction of assigned works and industries. It was also believed that the schools should prepare young people for agricultural teaching, both stationary and itinerant. In its conclusions, the commission proposed the consolidation of all agricultural institutions under a single ministry, though the specific ministry was not specified. The need for comprehensive development of exercises was also reiterated, as well as the importance of providing schools with the necessary resources to establish adequate laboratories, experimental fields, agricultural farms, and industrial demonstration plants. Regarding the method employed in the appointment of professors, it was hoped that these procedures would conform to those implemented in the universities, including the establishment of examination committees. Finally, it was proposed that a further joint commission, comprising representatives from both the schools of application for engineers and polytechnics and the colleges of agriculture, be entrusted with the task of formulating concrete proposals about the training of agricultural engineers. These proposals were to be considered in conjunction with those of masters in agricultural sciences, who were deemed particularly useful for engineering applications to rural problems, especially those involving land reclamation, irrigation, and land transformation (Bidolli and Soldani, 2001).

On the basis of the findings of this commission, Arrigo Serpieri, Undersecretary of State for the Economy, with the support of Alessandro Brizi, Director General of Agriculture, and Orso Corbino, head of the newly formed Ministry of the National Economy, took concrete steps and a legislative path to transfer to the Ministry of the Economy all the Higher Schools that had a predominantly technical-practical character, including those of agriculture and veterinary medicine that had been assigned to the Ministry of Public Education. In 1923, Serpieri sent a memorandum to Giovanni Gentile, Minister of Education, in which he justified, with a lucid and detailed analysis, the transfer of all the agricultural schools to the Ministry of the National Economy. The memo also analytically examined the condition of each of these schools. In particular, those dependent on the Ministry of Education pointed out that: "*the school in Pisa was allowed to languish to the state of decay in which it now finds itself, and the one in Bologna was not allowed to flourish, even though [both] arose in an extraordinarily favorable agricultural environment*". On the other hand, the schools that had been under the MAIC's control were substantially well organized and also served as technically decentralized bodies for some important public functions of agricultural policy for the Ministry of Agriculture, particularly concerning agricultural mechanics. Moreover, the Higher Forestry Institute in Florence was organized, since its origin, "*not so much because of its limited didactic function, but as a large experimental institute, to which the Ministry gradually entrusted the task of carrying out those researches and experiences that were worthy of marking the surest way for the direct activity of the State in the field of reforestation and management or protection of public forests, and for the activity of private forest owners*" (Bidolli and Soldani, 2001).

The consensus obtained as a result of this persuasive petition enabled the technocrats of the Ministry of the National Economy to centralize all agricultural and veterinary medicine education under their control, starting in 1923, with the creation of several Higher Institutes. Serpieri in particular believed that: "*It is good that, within certain limits, each of the Institutes should have its own physiognomy, adapted to the environment in which it lives, also because the experimental and educational resources could hardly in practice be equally rich and complete in all branches of agricultural studies. A certain freedom of choice granted to students among different teaching groups during the ordinary four-year period, and special supplementary teachings reserved for the fifth year will make it possible for each student to intensify his or her preparation in one or other of the main directions: applied biological and economic studies, management of agricultural enterprises, professional practice in technical-agricultural work, estimates, etc. There may also be some differentiation among the different Institutes concerning these addresses. Because of the proposals that will come in this regard from the Academic Councils of the individual Institutes, it remains an important task for the Ministry to select and coordinate them so that, within the Institutes as a whole, all the needs of the country are adequately met*" (Serpieri, 1925).

Given the potential overlap between engineering and agricultural studies, and the establishment of agricultural engineering courses, which had been prevalent in international educational institutions, Serpieri argued for the maintenance of distinct academic domains. He asserted that the integration of an agricultural engineering course within engineering studies, or the augmentation of mathematical disciplines in agricultural higher schools, was impractical. The two fundamental preparations should differ substantially in their mathematical and chemical-biological characteristics. As Serpieri asserts, "*the foundation and orientation of the two courses should be substantially different. The attempt to establish a unified educational program for engineers and agronomists within the same institution would undoubtedly result in the production of substandard engineers and agronomists*" (Serpieri, 1925).

Decree No. 2492 of October 31, 1923, sanctioned the transfer to the Ministry of the National Economy of all Higher Schools of Agriculture and Veterinary Medicine, which took on the name of Institutes of Higher Education. Moreover, the National Forestry Institute in Florence became the Higher Institute of Agriculture and Forestry, since the government's new forestry policy did not require pure foresters, but rather agronomists-foresters who would be trained through a specialization to be carried out within the agricultural higher education. Admission to all these new institutes was restricted only to young people coming from classical and scientific schools. However, the administrative autonomy of the institutes and the academic character of the degree were reaffirmed. It was also established that their educational system would be divided into an ordinary four-year period of study and a fifth year, after graduation, of specialization, with the details proposed by each institute and with differentiation according to the area in which they were located and to the particular tasks that they wished to privilege. For those who wished to devote themselves to professional practice in the field of technical-agricultural work and evaluation, a state examination was established, for which agricultural science graduates had to prepare themselves on their own initiative, to acquire those strictly professional notions that the school did not or could not provide (Santini, 2015). In 1924, the merger of the High School of Florence with the High School of Pisa was also established. However, the merger did not actually take place due to the strong opposition taken by the local authorities of the two Tuscan provinces (Ferrari, 1926). In that year in the institutional field also made its appearance with the "*Consiglio Nazionale delle Ricerche*" (CNR, National Research Council of Italy), which in 1929 established the National Committee on Agriculture, chaired by Minister of Agriculture Giacomo Acerbo.

These legislative measures were followed by others to better specify and organize the higher agricultural studies under the Ministry of the National Economy. A few years later, however, the new direction given to agricultural and forestry education was again called into question, and the choices of 1923 were completely reversed, despite the firm opposition of Arrigo Serpieri and the Minister of the Economy, Giuseppe Belluzzo, who argued the desirability and merits of non-academic management of technical and agricultural education. A political-cultural bloc determined to downsize the reformers prevailed, and in November 1927 the "*Gran Counsiglio*" of Fascism adopted a directive to unify and concentrate school policy and administration and advocated the transfer of the newly created and regulated institutions to the Ministry of National Education, which had recently replaced the Ministry of Public Education. The law of December 20, 1928, No. 3230, sanctioned this transition and put a definitive end to the often-heated disputes, with fluctuating outcomes, over the ministry to which it belonged and the specifics of agricultural education that, since the establishment of the Kingdom of Italy, had involved eminent personalities and powerful institutions. Then, in August 1933, all the laws on higher education were consolidated in a single text (Royal Decree No. 1592), initiating a gradual process of homogenization between agricultural and forestry qualifications and other university specializations, which was completed in the years 1935 and 1936, with the transformation, through specific decrees, of the six Higher Institutes into University Faculties of Agriculture, to which were later added those of Turin (1936), Bari (1938) and Palermo (1942). The national organization of the Faculties of Agriculture was regulated by Royal Decrees 2044/1935, 882/1936, and 1632/1938, which divided the teaching subjects into two two-year terms and distinguished them as fundamental and complementary (Santini, 2015b).

However, the agricultural technicians who had graduated from the Higher Schools before World War II had a group compactness and a homogeneity of beliefs and ideas that came from the experience they had gained in dealing with the complex problems of the development of agriculture in Italy. These characteristics remained unchanged until the implementation of the agricultural reform, the completion of land reclamation, and the establishment of irrigation in the Sud Italy. Agricultural higher culture, moreover, from its origins has been the most effective tool for spreading knowledge of the national environment, its resources, and local diversity, and has actively supported their improvement.

Over the years, agricultural technicians have gone through the training of different figures: from the natural scientist to the specialist, from the researcher to the experimenter, and from the professional to the technical politician. In all cases, however, there have always been personalities who were convinced that they had an intellectual and civic responsibility that went beyond the provision of specific technical skills. This has had a significant impact in Italy, even during years when the professional project was weak. Agricultural higher studies in the past had a continuity that considered the ethical-political dimension essential, the affirmation of the centrality of the agricultural sector in Italian politics, and the specificity of rural values. With the subsequent emergence of specialized agriculture and Italian industry, with the radical transformation of agricultural activities, and with the widening of the landscape of studies to include even broader visions, the bond that had held together agricultural science graduates of different generations and different ideas and aspirations has certainly weakened, and activities mainly within state bodies and technical assistance to private individuals, including through the state, became more common for agronomists (D'Antona, 1991; Rossi-Doria, 2000).

Early developments after World War II

After World War II, the number of agricultural sciences departments in Italy increased considerably; by the end of the twentieth century, there were more than twenty. The number of graduates has reached an important milestone. The graduates in agricultural sciences, although they have always represented a minority among the Italian graduates, have continued to play a fundamental role, with uniformity of training and decision-making and operational capacity, in giving Italian agriculture international competitiveness and, in general, maintaining its progress (Santini, 2015c).

At the end of the Second World War, however, the mechanization of agriculture in Italy was still inadequate and primarily reliant on metal-wheeled tractors with low average power (19 kW). Market analysis revealed that these tractors had limited market prospects and were primarily used for tillage. The ancestral management of farms was undergoing rapid change, partly as a result of the massive exodus of labor from the countryside, and mechanization in agriculture became firmly established. The number of tractors in Italy increased from just over 50,000 in 1950 to 300,000 in 1960 and then approximately 1.5 million in 1990. The production and sale of agricultural machinery in Italy have increased significantly over the years. In 1950, the production was approximately 4,000 tons per year. By the end of the 20th century, this figure had increased to approximately 250,000 tons per year. Concurrently, the cultivated agricultural area was experiencing a

significant decline (Pellizzi, 2000; Santini, 2002).

Significant developments took place in the field of agricultural engineering in Italy during the initial post-World War II years. In 1951, the Fourth CGIR Congress (CIGR, 1951a, 1951b) was held with the support of the Italian Ministry of Agriculture and Forestry and the Italian Committee of the Food and Agriculture Organization (FAO). The organizers of the Congress sought to transport the participants across the Italian peninsula, arranging a series of technical visits to the primary works undertaken in Italy following the devastation of World War II. These endeavors focused on pivotal areas such as land reclamation, agrarian systems, and collective irrigation. On April 22nd, the congressmen were greeted in Milan by Gino Passerini, who was representing the Italian Minister of Agriculture and Forestry. From April 23rd to 24th, they visited the Trade Fair in that city, the "*Istituto Sperimentale Lazzaro Spallanzani*", and the local Faculty of Agriculture at the University. On April 25th, the technical study excursions to some reclamation consortiums in Lombardy were initiated, and then continued toward Rome, with stops in Bologna and Florence. During these excursions, further technical visits were made to some reclamation works carried out in central Italy. From April 28th to May 1st, the congressmen were in Rome, where they were welcomed by the Director of the FAO Division of Agriculture (Dr. Wahlen) and where the Congress was officially opened by the president of the CIGR (Armand Blanc, Head of the Institut National Agronomique in Paris). In Rome, the more than 45 scientific reports submitted to the Congress were reviewed and discussed. The reports were organized in topic groups according to CIGR Technical Sections. During their stay in Rome, the delegates also visited the archaeological excavations at Ostia (Figure 9). On May 2nd, the delegates arrived in Salerno while visiting during their journey the reclamation areas of Agro Pontino and Fondi. On May 3rd, a visit was organized to the Paestum Land Reclamation Consortium on the left side of the Sele River. President Carlo Santini led the participants on a tour of the reclamation works that had been carried out. These works led to the development of a new and more efficient agriculture in the area (Figure 10). The IV CIGR Congress ended in Naples on May 4th, 1951. The event took place at the headquarters of the Bank of Naples, where Gino Passerini also delivered a short speech on behalf of the Italian Minister of Agriculture and Forestry.

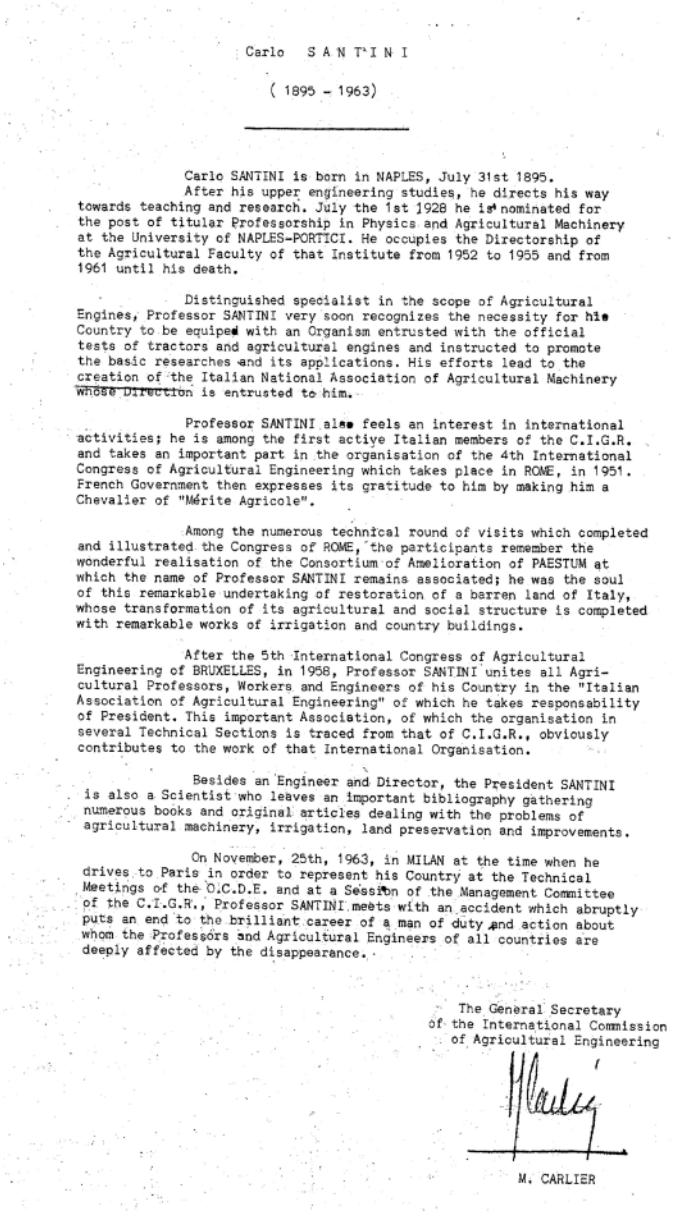
In 1959, after the 5th CIGR Congress held in Brussels (which began on October 2nd, 1958), the "*Associazione Italiana di Ingegneria Agraria*" (AIIA) was founded in Italy, on the initiative of Carlo Santini, who was the director of the Institute of Agricultural Mechanics at the University of Naples. After Carlo Santini's sudden death (in November 1963), Michel Carlier,

Figure 9. IV CIGR Congress: participants visiting the Ostia Antica archaeological excavations on April 29, 1951 (Santini Archive).

Figure 9. Paestum Land Reclamation Consortium. Visit by participants in the 4th CIGR Congress, May 3, 1951. Some congress participants are pictured in the following scenes: on the left, near the road siphon bridge crossing the "La Cosa" stream; on the right, at the Paestum archaeological excavations, with the Temple of Neptune in the background (Santini Archive).

Secretary General of the CIGR Committee, wanted to commemorate his activities in support of CIGR in an obituary sent to all members (Figure 11). AIIA was established as an affiliate of CIGR and adopted its organization into Technical Sections in which members were grouped according to their technical and scientific interests. The inaugural AIIA National Conference was held in Portici (Italy) on 14th-15th April 1966 (AIIA, 1967), and was followed by several others in regular sequence. Since its foundation, AIIA has consistently aligned with the organizational and scientific orientations of the CIGR and has increased the number of its members, who are not only university professors or members of academic institutions, but also scholars, engineers, agricultural technicians, professionals, companies, international organizations, and Italian public and private bodies. The development and expansion of engineering applications in agriculture subsequently required several changes to the AIIA Statutes, including an expansion of the number of Technical Sections.

The presidents who have led AIIA have always encouraged its members to participate in international events in the field and have promoted events and conferences on topics of national and international interest. AIIA is currently an affiliate of the "*European Society of Agricultural Engineers*" (EurAgEng), as CIGR has abandoned its initial, specifically European character and is increasingly taking on the role of an international society for coordinating local scientific and research societies in the field of agricultural engineering. This initiative involves nations from all continents. The 12th CIGR International Congress was held in Milan in 1994. This event was made possible with the tireless and highly qualified efforts of Giuseppe Pellizzi, Director of the Institute of Agricultural Engineering at the University of Milan, who also served as President of CIGR from 1991 to 1994.



Carlo S A N T I N I

(1895 - 1963)

Carlo SANTINI is born in NAPLES, July 31st 1895.
After his upper engineering studies, he directs his way towards teaching and research. July the 1st 1928 he is nominated for the post of titular Professorship in Physics and Agricultural Machinery at the University of NAPLES-PORTICI. He occupies the Directorship of the Agricultural Faculty of that Institute from 1952 to 1955 and from 1961 until his death.

Distinguished specialist in the scope of Agricultural Engines, Professor SANTINI very soon recognizes the necessity for his Country to be equiped with an Organism entrusted with the official tests of tractors and agricultural engines and instructed to promote the basic researches and its applications. His efforts lead to the creation of the Italian National Association of Agricultural Machinery whose Direction is entrusted to him.

Professor SANTINI also feels an interest in international activities; he is among the first active Italian members of the C.I.G.R. and takes an important part in the organisation of the 4th International Congress of Agricultural Engineering which takes place in ROME, in 1951. French Government then expresses its gratitude to him by making him a Chevalier of "Mérite Agricole".

Among the numerous technical round of visits which completed and illustrated the Congress of ROME, the participants remember the wonderful realisation of the Consortium of Amelioration of PAESTUM at which the name of Professor SANTINI remains associated; he was the soul of this remarkable undertaking of restoration of a barren land of Italy, whose transformation of its agricultural and social structure is completed with remarkable works of irrigation and country buildings.

After the 5th International Congress of Agricultural Engineering of BRUXELLES, in 1958, Professor SANTINI unites all Agricultural Professors, Workers and Engineers of his Country in the "Italian Association of Agricultural Engineering" of which he takes responsability of President. This important Association, of which the organisation in several Technical Sections is traced from that of C.I.G.R., obviously contributes to the work of that International Organisation.

Besides an Engineer and Director, the President SANTINI is also a Scientist who leaves an important bibliography gathering numerous books and original articles dealing with the problems of agricultural machinery, irrigation, land preservation and improvements.

On November, 25th, 1963, in MILAN at the time when he drives to Paris in order to represent his Country at the Technical Meetings of the O.C.D.E. and at a Session of the Management Committee of the C.I.G.R., Professor SANTINI meets with an accident which abruptly puts an end to the brilliant career of a man of duty and action about whom the Professors and Agricultural Engineers of all countries are deeply affected by the disappearance.

The General Secretary
of the International Commission
of Agricultural Engineering

M. CARLIER

Figure 11. The Carlo Santini Memorial, distributed to CIGR members by Michel Carlier, General Secretary of the International Commission of Agricultural Engineering (Santini Archive).

Concluding remarks

After World War II, the AIIA played a pivotal role in promoting and guiding the revitalization and modernization of the agricultural sectors in Italy. New principles were introduced for organizing labor and using machinery to reduce production costs. The mechanization of agricultural practices has been instrumental in reducing cultivation costs for various crops. This reduction is particularly evident when compared to the immediate post-war period and has often been facilitated by the establishment of cooperatives that allow for collective use of machinery to perform essential tasks at predetermined rates. The AIIA also founded the "*Journal of Agricultural Engineering*", its official scientific journal. Additionally, the Fund for southern Italy (*Cassa per il Mezzogiorno d'Italia*) carried out numerous land reclamation projects in marshy and unhealthy areas using public funds. These projects included the construction of impressive collective irrigation systems that made intensive farming possible in new areas, especially in southern Italy.

Recently, the agri-food sector has undergone significant qualitative changes due to European Community agricultural policies. Demand for food has favored high-quality products, and concerns related to well-being have increased, particularly in advanced societies. Agriculture has been assigned a crucial role in protecting natural resources, landscapes, and biodiversity, as well as in strengthening the social and economic fabric of rural areas. In the late 20th century, scientific and technological developments underwent a surprising evolution that quickly led to significant changes in daily life. These advances have made new, highly effective tools available, particularly in electronics, computers, information technology, artificial satellites, sensors, and telecommunications. The agricultural sector has benefited from this process, and scientific research increasingly involves a "team effort" that often requires theoretical speculation to solve practical problems, including the use of human creativity. Distinctions between traditional scientific fields, such as physics, mathematics, chemistry, and biology, have faded in favor of greater integration to solve practical problems involving fields that were once considered distinct. In Italy, agricultural and biosystems engineering has seized these opportunities by using new technologies to improve the efficiency and productivity of the agri-food system, in line with global economic and social progress.

New issues and new technological innovations are constantly emerging and will continue to emerge in a sector that has the fundamental task of producing food for the growing demand of a rapidly increasing world population, with a view to safeguarding and enhancing the environment, ecosystems, and biodiversity. Agricultural and biosystems engineering is poised to address future agricultural and environmental needs, as well as to protect natural resources, by leveraging its established capacity to do so. Additionally, the field is well-positioned to increasingly align with global trends and developments in Italian food sciences.

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