

Maccarese – From agriculture to food tech

Trading-Up and De-Commoditizing Valuable Raw Materials

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MACCARESE

Introduction

“Misurare per conoscere” – Measure to know – is the motto of Maccarese S.p.a., and the summary of how the organisation operates. Not only one of the most historic farms of Italy, it is also one of the largest. Over the years, since it was bought off from the Italian Government by Edizione S.p.a., one of Italy’s most prominent holding companies, it strived to adapt to change, to incorporate the most modern industrial techniques and technologies, and to innovate both in terms of operations and organizations. The current top management – Andrea Benetton, President, and Claudio Destro, CEO – set its vision to have every decision to be data-driven, including the ones on milk yield or crop performance, by gathering and leveraging a myriad of data-points from sensors spread out in the entire farm: a way to achieve efficiency while caring deeply about animal health, the environment and its community, and by producing end-products of the highest quality possible. In a discussion that took place during the latest management committee, however, a relevant set of new challenges became evident. On one side, end-customers, that shop for milk and dairy products at retailers, have limited possibility to distinguish the quality of a top milk product and understand the differentiation elements, when comparing dairy products to the one of farms much less structured and less attentive to quality and transparency of their end-products. In the end, how to ensure that end-customers understand the quality, and assign the proper value, to Maccarese S.p.a.’s operations? On the other hand, another point of the discussion was whether increasing attention by the Company on themes connected to Social Responsibility and on reshaping its purpose, was understood enough by the general public and the relevant stakeholders. Are these themes sufficiently connected to the vision of introducing the technology to the farming activities? So, while producing a variety of milk that, thanks to the care that is put towards the cows, their well-being and the quality of the food they eat, Maccarese S.p.A. finds itself at an impasse, that requires a solution that will guarantee the company’s future in the short and long-term. How then to ensure that all the efforts in terms of animal health and environment preservation are highlighted and valued in the right way? And, most importantly, how to make sure that other companies can be pushed towards the same goal of respecting the environment, and everyone who lives in it?

About the Company

Maccarese S.p.A. is located in Lazio and constitutes a huge part of the territory of the municipality of Fiumicino. Maccarese is, in particular, a fraction of said municipality, and is very close to Rome. Its main activity is the production of cow milk, with a daily output of 57.000 litres of high-quality milk. In a vertically integrated organisation structure that revolves around this activity, it also operates on other three sectors, all related to the farming world, intertwined and complementary: breeding, cultivation, and energy production. It is also one of the oldest and most historically relevant farming companies of the country.

The surface area on which the company is based, and on which the aforementioned activities take place, is 3.240 hectares (32 square kilometres) [Figure 1]: this makes Maccarese one the largest farms of the entire country. It is bordered by the Tirrenian sea for around 12 km. Moreover, it finds itself in a unique position in terms of means of transportation: it is closely located to Rome, the Italian capital, the airport of Rome Fiumicino is adjacent to the land, the port of Civitavecchia is nearby, and it can also count on Maccarese's train station.

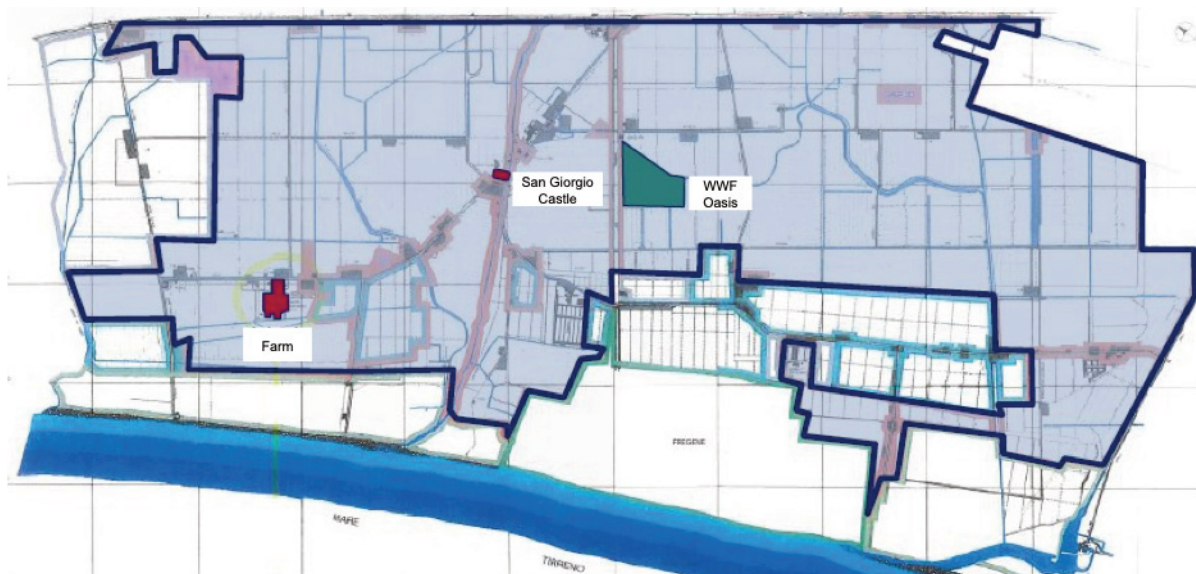


Figure 1. Map of the Company's Land

For what concerns breeding, it hosts one of the largest cow milk breeding enterprises of the country: 3.600 Friesian cows. Alongside this kind of breeding, Maccarese also operates a fattening business for the male calves that are born in the company, the output of which is sold to large-scale distribution Ho.Re.Ca. businesses that operate in the Rome area.

Regarding cultivation, 24 square kilometres of the land are entirely devoted to producing crops such as cereals, protein crops, fodder, and vegetables. Moreover, it is a leader in Italy for what concerns almond cultivation, with 120 hectares of planted soil. Part of all this output is employed in order to provide the best nutrition to the cows that live in the farm.

While being a primary sector company, it leverages managerial practices and organisational techniques that are more related to the industrial world. In particular, it gathers and leverages an enormous quantity of data in order to make all its decisions. Specifically, various technical and technological advancements are employed in order to provide the best efficiency, quality and performance of crop and milk outputs, and animal welfare.

Company History

The land on which the company is based had been, since the 1700s, the property of the prominent, noble, Rospigliosi family, which could count a Pope among its members. Back then, Maccarese was a large swamp in which people would die of malaria – a difficult terrain type for agriculture. In 1915, Prince Rospigliosi devised a plan to reclaim the muddy land and began a first effort in that regard. Yet, in part because of the first World War, in part due to significant financial problems, the plans were abandoned before they could reach the required level of reclamation.

The company that today is known as Maccarese S.p.A. was born in 1925 with the name Maccarese SAB, *Società Anonima Bonifiche*, and was headquartered in Milan. It was created in order to properly reclaim land for 4500 hectares in the Fiumicino area, just a shot away from Rome, as part of the great reclamation effort promoted by the Fascist Government.

In 1929 the world-wide crisis forced its owners to sell it to I.R.I., *Istituto per la Ricostruzione Industriale*, a company belonging to the government. I.R.I. was instituted in 1933 with the aim of coordinating a series of actions to finance and restructure private companies that had collapsed during the Great Depression. Maccarese thus became part of this holding company.

In its long history across the 20th century, it achieved some major results, such as being a forerunner in implementing equal pay in 1961. It leveraged an organisational style known as *mezzadria*, shared cropping, in which many different small farming initiatives were present on its land, and only the milk, the end product, would be deposited centrally. In the 1980s there was a shift from this paradigm to that of centralisation, and the first main stable was built. Maccarese was such as relevant company for the country and the state that Giulio Andreotti, seven times Prime Minister of Italy and 32 times Minister, was a guest at its inauguration.

Yet, in 1983 it was contributing to I.R.I.'s annual balance with the equivalent of €100M of losses. After many failed attempts to revive the company, it was thus put on the market. Its sale was com-

plex, and took many years to finalize, across withdrawals and vetoes from political parties that reached a national scale. Regulators, citizens, and the government were especially concerned about the danger that the territory, an enormous green area in a prime location in front of the sea, would be subject to construction projects that would destroy its beauty.

Finally, in 1998, Maccarese S.p.A. was purchased by the Benetton Group through its Edizione Holding investment vehicle for 93 billion Italian Lira, around €48 Million today. The only clause that its territory would be kept to its original shape and cultivation use, without any further construction of new buildings.

Since the inception of the new Edizione era, modern industrial and managerial techniques were applied in order to bring it to the highest levels of innovation and competitiveness. At the time of purchase, it was home to around 900 cows, and much of its infrastructure and surface were not usable. In order to make the best out of its investment, the group decided to move part of its trusted management of its historical clothing industry to the new company, specifically Claudio Destro as General Manager and Silvio Salera as Chief Executive Officer, positions in which they stayed for more than 20 years. It took the new management around 5 years to fully restructure the company, as it first had to learn everything about Maccarese, its long history and its operations. This restructuring focused not only on the territory and on the operations, but also on the people culture.

In 2001, cows were equipped with the first generation of pedometers, in order to provide accurate data on animal activity and heat. 2003 saw the reconstruction of the first half of the milk parlour, which was completed in 2005.

Ownership

As of 1999, Maccarese S.p.A. is a privately held company and is part of Edizione S.r.l. Established in 1981, Edizione it is one of Europe's main holding companies. Its investment policy is focused on international growth, and tries to virtuously combine ownership and management in a long-term view, all while respecting a very strong Code of Ethics. It is an active investor, that employs both an entrepreneurial approach with a rigorous financial discipline to support its company portfolio not only financially but also strategically.

Edizione S.r.l. belongs to the Benetton family, one of the most prominent entrepreneurial families of the entire country. Each of the four family branches possess equal quotas of 25% each through their investment vehicles: Evoluzione, Proposta, Regia e Ricerca¹, which in turn belong to the respective family members.

Its success stems from the prosperity of the constellation of Benetton clothing brands. Founded by the four Benetton brothers in Treviso in 1965, and characterised by a unique and peculiar communication style, it has been a leading international player for more than 50 years. The brand

1. https://www.edizione.com/wp-content/uploads/2020/09/ED_companyprofile_ita_set20.pdf.

has been synonymous for decades with the success of so-called made in Italy products, representing values of sustainability, tradition, innovation and an international outlook. The four brothers, quite early in their entrepreneurial endeavour, decided to diversify their areas of operations and revenue sources and further expand internationally.

Because of this, it has a wide investment and interest portfolio, both in Italy and abroad. Out of its €10B asset value (2021), the main areas are Transport Infrastructures (35%), Digital Infrastructures (28%), Real Estate and Farming (17%), Financial Institutions (10%), Restaurants (6%), and Clothing and Textile (4%). The most prominent participations are in companies such as Autostrade per l'Italia (88,06%), Aeroporti di Roma (99,38%), Autogrill (50,10%), Benetton Group (100%), Mediobanca (2,10%) and Assicurazioni Generali (3,98%). Some of the aforementioned businesses are publicly listed.

In 2020, Edizione produced a consolidated revenue of € 10.9 billion, out of which 43% was generated in Italy and 57% abroad; though its various companies and participations, it employs more than 100.000 employees as a whole, in various continents.

As highlighted in Figure 2, the shares of Maccarese S.p.A. are held in full to Edizione Agricola S.r.l., which is itself fully owned by the main holding. Edizione Agricola is a sub-holding company that functions as a container to all the international breeding, farming and cultivation activities that are part of the group. It was established in 2019 to consolidate and organize those activities. With a capitalisation of €1M, it has net assets for €93M. In Argentina, **Cia de Tierras S.A.** and **Ganadera Condor**, are leading livestock breeding, wool and crop producing companies based in Argentina; Acquired in 1991, they produce an annual turnover of 13.6 M€ with more than 255.000 livestock on 938.000 acres of land. They jointly own 95% of Frigorifico Faimali, a company specialized in processing and commercializing sheep meat.

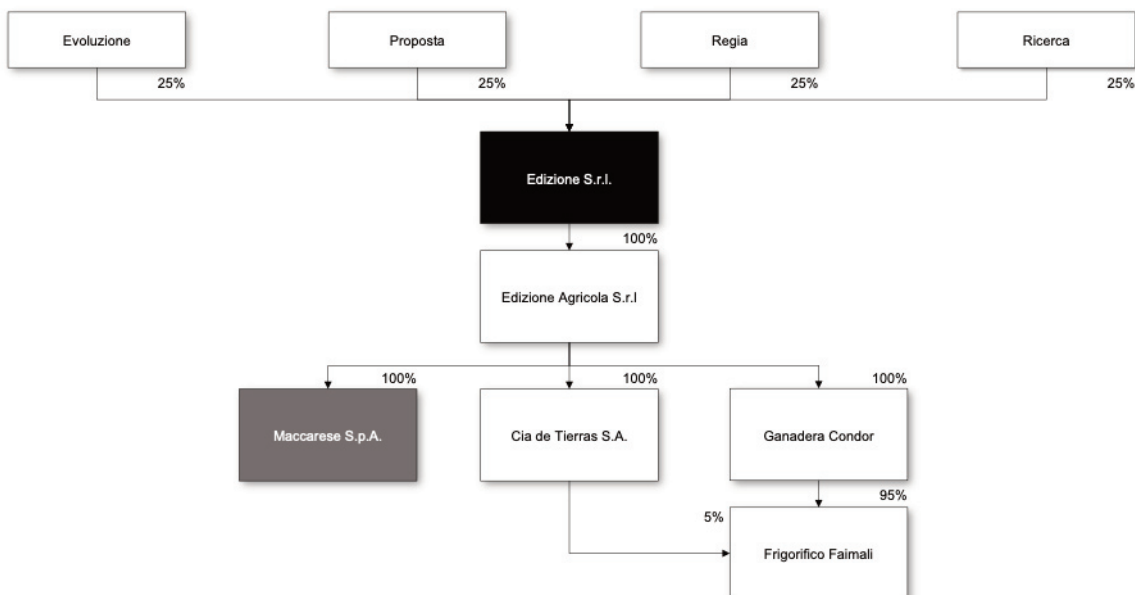


Figure 2. Company Ownership and Structure

Leadership

The company strives to adopt an industrial approach in every part of its operations, and this reflects also on the way its leadership is composed.

Its efficiency allows it to function with adequately sized personnel. In terms of organization, for example, the company has one manager that is in charge of the entirety of the stable, but it leverages various managers under him that focus on just one aspect of the production, ranging from animal living welfare, to feeding and breeding. These sub-areas are then completely intertwined, and the people responsible have a constant relationship. Specifically, the main output of the company is how well an animal lives, and this stems from various elements that join up in the macro-areas of living conditions, and nutrition. Such a hierarchy allows to easily track down issues and understand who to talk to when there is a need to improve something.

As of 2019, the President is Andrea Benetton, and the CEO and General Manager is Claudio Destro. In addition to the top managers, the company is organised under the following:

- Administration and finance Manager
- Stable Manager (Meat and Milk)
- Biogas Plants Manager
- Technical Office Manager
- Land Maintenance Manager
- Land Handling and Phytochemicals Manager
- Food Quality Manager

Business Areas and Key Financials

Maccarese S.p.a. generated overtime an increasing amount of revenue. In 2020 it had a revenue of €13,4 million, a 7,8% increase from the previous year. Profits have been rising accordingly by 6,9% YoY, to €954.237.

Maccarese S.p.a.'s activities focus on three business areas, that are complementary and intertwined, in order to generate synergies: 1) zootechnics, 2) agriculture, and 3) energy production. The zootechnic activities bring in 62,02% (€8.3M), cultivation amounts to 5.2% (€0.7M), and the energy production and resale sector brings in 24,7% (€3.3M); other revenue sources such as rent fees, that stem from renting farmland to local operators, bring in an additional 8% (€1M). In terms of margins, it has a healthy Profit margin (Profit/Revenue) of 7,1%.

The firm has been leveraging a vast part of its revenue to improve itself year after year, re-investing on research, new technologies and infrastructure. Since 1999, the year when Edizione took charge of the management of the operations, € 48 M have been invested on projects such as the creation of new stables, the two biogas plants, and the complete restoration of the Castle of San Giorgio present on the company's grounds.

In 2019, the value of the land belonging to Maccarese could be estimated to be €180,8 Million. Based on a historical cost of €32,4 M bore by Edizione, the investment has already surpassed expectations.

Operations

The efforts undertaken by the firm moves toward the direction of the precision industry, by scientific backing applied to data with the ambition to *“use of data is what allows the farm to know exactly what to do, when to do it and how to do it”*.

In addition to that, *“the operations of the company have a keen eye on sustainability and ethics”*, says Andrea Benetton, President of the Company, with managerial choices aimed at *“identifying the best course of action that allows to increase animal, social and employee welfare and decrease the impact on the environment”*, leveraging circular economy strategies.

Zootechnics – Milking and Breeding

Maccarese constitutes one of the largest milk cow farms of the entire country. It is home to around 3,600 cows, out of which around 1,300 are lactating at any given time. Moreover, around 600 are fattening calves, that are employed to produce high-quality meat. Milking cows jointly produce 57,000 litres of high-quality milk daily. Moreover, calf is bred and then resold with the aim of obtaining edible meat.

In more detail, the annual output is of around 18 million litres. This milk is sold mainly to two companies, that then process it and deliver it to the end customer: Centrale del Latte di Roma, part of the Parmalat Group, and Ariete Fattoria Latte Sano, which jointly contribute to 92% of the company’s revenue. This production is employed in order to satisfy approximately 15% of the daily milk requirements of the entirety of Rome.

Innovation

The firm tries to enact a deeply scientific approach when handling its cow population. It is driven by a series of techniques that are identified as precision zootechnics, that employ a data-driven, constant feedback process in order to ensure animal welfare and output quantity and quality.

In particular, the firm believes that milk quality shares a deep connection with animal welfare: a balanced diet, an equilibrium between rest and activity are positively correlated both with high quality and high yield. With this in mind, ensuring that cows are well is a great driver for quality. Maccarese has been a precursor in digitalising and monitoring every single aspect of the life of each cow, from nutrition to physical activity, culminating with lactation. They divide their technological endeavours in two main areas: a) monitoring of physical parameters and behaviours of animals, and b) management of herd nutrition.

The peculiarity of Maccarese’s analyses is: instead of thinking of the cows as part of a single herd, and of the milk as a unicum in a huge reservoir, data points are collected on every single cow, and on every millilitre of milk, with the end objective of assessing and improving the welfare of every single cow.

For what concerns **the monitoring of physical parameters and behaviours of animals**, the aim is to gather extensive data via a network of sensors, and to leverage this data to improve animal

conditions. Physical parameters are gathered in two different settings. The first one is direct, and monitors parameters that are related to physical activity. Each lactating cow is equipped with a pedometer called AfiActII, applied to one leg like a bracelet, that monitors rest periods locomotor activity. In addition to that, AfiCollar, a cow neck collar, is used to determine, through motion sensing, levels of rumination and of other health parameters, correlating this data with nutrition efficiency [Figure 3]. Moreover, animals are equipped with sensors in their vaginas to monitor temperatures, and to track heat stress during summer months to regulate the refrigeration of the animals’ living environment. This helps maintain production performances.

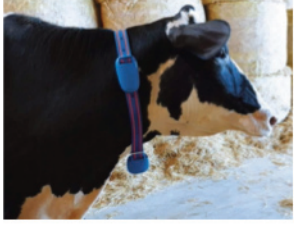

Technology Name	Technology Usage	
<ul style="list-style-type: none"> ▪ AfiCollar 	<ul style="list-style-type: none"> ▪ Collar with motion sensors and accelerometers to monitor motion patterns (rumination, heat...) 	
<ul style="list-style-type: none"> ▪ AfiAct II AfiTag 	<ul style="list-style-type: none"> ▪ Leg-attached pedometer, wireless connected to a monitoring system, that measures walking/resting/standing activity 	

Figure 3. Technologies

The second one is indirect, as it’s based on milk production. At the milking stage, animals are identified through their unique wireless ID tag by the automatic milking machine. This machine stores a variety of parameters, such as liquid volume and electrical conductivity, to measure the incidence of mastitis via correlation. Once the milk has been extracted, it passes through a milk analysis laboratory. Sampling is not employed: all the milk gets analysed. By employing NIRS, Near Infra-Red Spectroscopy, the liquid is decomposed and measurements on components such as fat, lactose, bacterial load and proteins are determined and stored right as the milk is being collected. This is particularly useful, as this data can be employed to optimize animal nutrition in real-time by calibrating their food intake based on the milk output, both in terms of quantity and of quality. Analysing milk components is also important to determine whether the cow is

sick: the firm's approach provides algorithmic, literature-driven evaluations on elements such as Milking and Nutritional Value, Pathologies (Lameness Risk, Mastitis, Ketosis, etc.) and can be leveraged to act immediately to provide care to sick animals.

Relatively to the management of herd nutrition, all the data gathered with the previous steps is employed and passed through custom-developed scientific models to ensure that each and every animal is getting the best food possible in a tailored way. For starters, NIR systems are employed to assess the quality of the food products and optimise rationing. Moreover, the crops and fodder that Maccarese produces for its herd are georeferenced and monitored through precision farming techniques: this allows to know exactly the nutritional qualities of the specific food the animal is ingesting. In addition to that, software monitoring tools are employed to manage food stocks and to balance daily intakes. Finally, through digital refractometers the quality of colostrum is assessed, and this proves fundamental when feeding new-born calves. They can also take advantage of an automated distribution system that provides them with the quantity of milk they need to satisfy their needs.

An additional effort is to also adjust animal nutrition on the fly, automatically: through automatic mixing systems that combine ingredients from silos, the composition of fodder is adjusted based on the milk output. For example, an animal that is milked in the morning and that is shown to need more fibre, will be automatically given more fibre by the feeding system before it's milked again the same day. In the past years, this close monitoring of every aspect of a cow's life is a factor that has led to a significant increase in the daily average of milk produced per cow, of around 50% in a time frame of 10 years.

Efficiency is pursued with another goal in addition to the well-being of animals: reducing environmental impact. By ensuring that every resource, from electricity and water to food, is used sparingly and appropriately, and thus that no waste happens, Maccarese can reduce its impact on natural resources. Moreover, by re-cycling animal waste and employing it for energy generation, as it will be discussed below, this environment-friendly approach comes full circle.

Maccarese's advancements and adoption of modern industrial processes are not only limited to advanced data gathering capabilities. One of their main aims is to be able to transform all this data into tangible insights, and to derive actionable ideas and projects that can be implemented in the real world. All the aforementioned devices, plus various IoT environmental sensors, are connected to the farm's backbone, and feed information to server systems in which the data is archived. This data is then transferred to dashboarding and analytics systems that implement prediction and decision models. Another peculiarity of the firm's approach, that sets it apart from the competition, is that it does not make use of pre-determined, standard models and workflows: the ones that are employed have been developed specifically under the direction of Maccarese's Zootechnic team and are based on rigorous scientific research. They return exactly the information that the team needs, when it needs it, with the granularity that is required at the moment. In particular, data can be aggregated at the level that is necessary, ranging from the single animal to the milk lot to the entire herd, and thus allows for deep analyses and forecasts.

Specifically, cow health data is employed to establish a series of baseline values: any deviation from this baseline, such as a sudden increase in activity, can be meant to signify, as per the scientific literature on the topic, status changes such as the starting moment of a cow’s heat to improve fecundation results. This series of decision support systems is fundamental, as it can, as the word says, support human decisions by providing insights based on what it has been taught. In conclusion, at Maccarese S.p.A. the herd is not managed as a single, huge and faceless entity: but having access to detailed information concerning each and every cow allows for customised approaches that benefit cows, their welfare, and the quality of the milk they produce. This is a very strong differentiating factor that clearly positions the firm at the top of its league.

Agriculture

Maccarese is involved in many cultivation endeavours. Its main aims are that of providing sustenance to the farming animals, and of generating organic, sustainable combustible fuel for the energy generation biogas plants, but a part of this production is also destined to resale activities. The firm’s land is cultivated for around 2,400 hectares, 75% of its 3.240 hectares of total surface. The remaining 25% is divided between production plants, stables, warehouses and other unproductive land, and Mediterranean Scrub thanks to its proximity to the sea, as it can be seen in Figure 4. 20% of the cultivated land is rented out to other firms for their own production.



Figure 4. Land Composition Breakdown

As the firm's land terrain is the result of extensive reclamation efforts performed in the decades around 1920-1930, it is composed mostly of clayey and silty soil; the territories that are next to the coastline are of a more structure.

The last available data, produced in 2019, highlights that around 77% of the crops are destined to animal sustenance or biogas energy production, while the remaining 23% is resold. The main crops are corn silage, wheat silage, barley silage and triticale. Concerning wheat specifically, and part of it becomes grist; two high-quality varieties that are grown are the "Senatore Cappelli" and "Marco Aurelio", and part of it is sold to a partner pasta factory.

In addition to these crops, Maccarese keeps researching and testing different kinds of cultivations, to put its fields to the best use possible and extract the most value through diversification. Diversifying revenue streams is also very important in the agricultural field, as much depends on external factors such as weather conditions, customer preferences and animal and plant sicknesses and parasites.

An example of this is the inception of a three-year project of developing a 100 hectares wide almond grove, started as this specific cultivation has shown great revenue potential; currently, Italy imports huge quantities of almonds from California and is dependent from it. More in detail, a high-density plantation has been deployed, leveraging elements such as the complete mechanisation of the operations of pruning and harvesting, a low time to market, high yields and, of course, a reduction in cultivation costs. At full capacity, the new plantation is expected to produce around 5 tons of almonds per hectare, and recoup the investment in around 5/6 years.

Other experiments have been undertaken, such as planting pistachios and olives, to gauge whether they can be a feasible production opportunity for the company.

Being Latium an area in which rain is quite scarce during the summer months, the company cannot rely on rainfalls to provide adequate irrigation to crops. This issue is addressed by employing a vast network of irrigation equipment, both fixed and mobile, that has been developed and deployed throughout the years. Specifically, elements such as water pipes buried underground at different depths are used, in order to create a web of water points that are not easily accessible to roaming animals. Among other things, this prevents them from eating the plastic and creating leaks or damages such as crops dying for lack of water, problems that go unnoticed until it's too late.

Innovation

Maccarese S.p.a. is distinguished by its strong will to employ modern managerial and industrial techniques in its every endeavour, always looking at the future to improve itself.

For what concerns agriculture, it is focused on practices that apply the so-called precision farming principles. It leverages many technology-driven solutions in order to extract the most from every plant, to provide crops that are not only numerous and efficiently cultivated, but also of great quality. And because most of Maccarese's production is directed towards feeding its livestock,

the cow, as usual, is at the centre, and output correlates with good crops: having healthy, well-fed animals is the only way to obtain milk that is both high quality and of the right quantity.

With this aim, many technologies have been developed, fine-tuned and are put into use at the farm. They can be divided into two categories, those related to the land itself, and those that improve on the machines that perform crops and handle the terrain.

Many of these innovations are based on a specific technology: satellite. Through satellites, crops and terrains can be constantly monitored, looking not only at visible information but also at other data. Moreover, through GPS, hyper accurate positioning can be achieved, and that is of fundamental when conducting heavy farming equipment that requires precision in order to be effective [Figure 5].

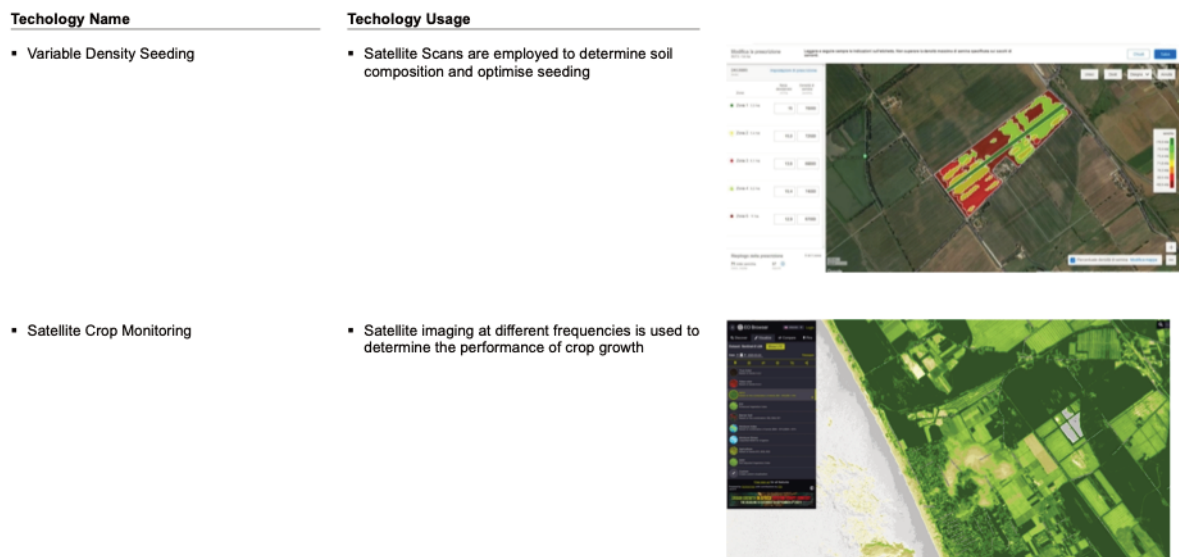


Figure 5. Crop Monitoring and Planning Technologies

The technologies employed to monitor the terrain are:

- **Variable Density Seeding:** land and soil are scanned in order to create a precise map based on factors such as composition, in order to determine the distribution and density of the seeds that will have to be planted, allowing farmers to give to each seed the perfect soil conditions and improve its performance.
- **Crop Monitoring:** satellite scans of crops are performed at regular intervals, and information that ranges from colour to thermal IR emissions is analysed and compared to benchmark values, in order to determine the performance of plant growth. Moreover, thanks to this data, it is easy to pinpoint the exact locations in which to deliver fertilizers and phytosanitary products.

- **Evapotranspiration Monitoring:** data from ground sensors such as rain gauges, anemometers together with weather forecasts and other elements is combined in order to assess the level of water consumption and absorption by plants. This allows a tailored, precise water administration and irrigation, that is both efficient for crops and allows to save precious water. In addition to that, pumping water around 3.200 hectares of land and maintaining a high enough pressure is quite energy consuming, and everything helps.

In addition to that, the irrigation infrastructure in place has been improved, with an advanced system that combines precision water dosing with a digital fertilizer distribution system, allowing for the right mix of them to be produced and given out. This amounts to decreasing the quantities of fertilizer used, together with a better irrigation efficiency and less manpower needed.

Furthermore, all this land, in every stage of the crop lifecycle, must be maintained and treated: this requires using heavy machinery, tractors and harvesters [Figure 6]. Maccarese leverages advanced technologies in this area as well:

- **Semi-autonomous driving:** vehicles such as tractors can leverage advantage GPS satellite-based localisation and navigation instruments to precisely pinpoint their location. This, combined with detailed maps, lets vehicles to effectively drive themselves on pre-determined paths. This allows making regular, efficient drives and to cover the entirety of the field in the fastest way possible: by doing so, needless driving is diminished, fuel consumption and pollution is reduced, and equipment lifespan is improved by decreasing usage and wear.
- **Heavy machinery monitoring:** extensive data is gathered on every detail of the usage of the machinery, with measures such as usage hours, operating parameters and working conditions. This allows to optimise the usage of the machinery, to monitor for faults and to plan for preventive maintenance.
- **Crop mapping:** every step of the cropping process is mapped and assessed, in order to further optimise journeys and passes and obtain a more homogeneous harvest. Moreover, by leveraging NIR Spectroscopy, or infrared imaging, elements such as crop humidity and nutrients can be monitored accurately in real-time.

In conclusion, efficient crop cultivations are more environmentally friendly, as they result in energy savings, less wasted water, and in general a more respectful attitude towards the environment, all values that are embodied in the soul of Maccarese.

And yet, at the core of the firm is a strong will to keep researching and innovating, also by leveraging collaborations with technological leaders that can share their expertise and advancements. For example, in 2021 a research partnership with Linkem, one of Italy's largest wireless technology providers, was established. As mentioned before, precision farming requires not only the ability to gather, through a network of sensors, a myriad of data points about every single aspect of the operations of the company, but also a way to connect simultaneously and in real-time to all these sensors. Linkem, already a supplier of FWA internet connectivity for Maccarese, will provide 5G connectivity to the sensor networks that are present throughout the land, the stables and the

Technology Name	Technology Usage
<ul style="list-style-type: none"> Semi-utonomous Driving 	<ul style="list-style-type: none"> Machines are driven automatically on computer-generated paths to increase efficiency
<ul style="list-style-type: none"> Weather Sensor Network 	<ul style="list-style-type: none"> Usage of weather stations to create hyperlocal data and optimise irrigation



Figure 6. Cropping Technology

other production buildings. Building on the efforts of Linkem 4Farm, Linkem’s in-house R&D division that focuses on agriculture, an ad-hoc solution has been developed to integrate advanced IoT sensors with AI algorithms to analyse output data, all intertwined with satellite images. The output of these analyses will be employed, among other goals, to rationalise water resources and make irrigation a more efficient and environmentally respectful process.

Energy production

Maccarese S.p.A. constantly actuates sustainable practices: part of it consists of taking advantage of new, environment-friendly energy sources. This, together with many energy saving and efficiency measures, is done in order to achieve a better, low impact on the planet. With this goal, circular economy practices have been put into place.

Operating a farm means requiring great quantities of electric energy, to perform activities related to animals, such as milking, refrigeration and storage, and climate control, but also to other areas such as cropping and irrigation, in addition to running heavy pumps to reach the required water pressure. It also means having access to various substances that can be employed to generate clean, cheap and sustainable energy.

In 2010 and in 2012, respectively, two state of the art biogas energy plants were built [Figure 7], to produce electricity employing animal slurry, manure, corn silage (created with a specific tech-

nique to store corn) and food waste. These two ingredients, in quantities of 325 m³/day and 63 m³/day, originate entirely from Maccarese's production, and are partly a byproduct of it. An oxygen-free fermentation process generates a mixture that is composed for around 50% by methane gas, which is burnt in the two co-generators, activating a dynamo system that generate electric energy. Even the by-products of the fermentation process are re-employed, both as bedding for milk cows, and as fertilizer. The investments, totalling €7,1M, allows the company to generate around 13,2 million kWh per year. Biogas plants are not only a great way to produce electricity efficiently, but also allow for a reduction of the presence in the atmosphere of the methane directly produced by bovine manure; finally, by using their waste as fertilisers, they improve soil richness without resorting to chemical and artificial products, thus once again benefitting the environment.



Figure 7. Biogas Production Plant

Beyond Operations

Leveraging information through data processing – the DEMETER project

As mentioned before, Maccarese S.p.a. is a data-driven company in each and every aspect of its day-to-day operations. This ranges from animal nutrition to their physical activity, right through milk outputs and quality, and also encompasses the handling of crops, seeding, harvesting and sustainable energy production. This area has been the subject of many investments and research across their history. And yet, this is not enough for them. Since it became part of Edizione in 1998, it has had a strong focus on research, and on employing academic rigour and modern managerial practices to become a market leader.

Among the many projects undertaken, since 2019, Maccarese has been part of an EU-backed R&D initiative, part of the aim of which is that of improving agricultural practices through the adoption of new, industrial technologies, in order to bring the EU's agri sector to the bleeding edge of competition.

The initiative is called DEMETER and belongs to the EU Horizon 2020 research project. This project is backed by Europe's member leaders and the European Parliament, and involves funds of almost €80 Billion over the years between 2014 and 2020. It aims to re-define cooperation in funding and scientific research of EU countries, and to attract and stimulate national and public investments.

DEMETER, specifically, aims to incorporate existing technologies in new applications related to the food sectors, thus modernising activities such as farming. In particular, it aims to leverage and promote the rapid adoption of technologies such as IoT, Big Data, AI and precision agriculture, all while guaranteeing cooperation and long-term sustainability. It operates on 20 pilot projects located in 18 countries, and involves around 6.000 farmers and more than 38.000 internet-connected devices. Maccarese is part of this network.

The pilot project of which the firm is part is held in cooperation with 4 actors from different industry sectors, and coordinated by Coldiretti. In addition to them, there is Ariete Fattoria Latte Sano S.p.A., a milk transformation and distribution company with strong ties to Maccarese S.p.A., which is leader within the Lazio Region for the distribution of milk and dairy products through Large Retailers and the Ho.Re.Ca. channels, with a daily collection of 200 tons of milk in the region. Alongside the production partners there are two technology providers that under their guidance have to implement the technologic solutions and advancements. They are Engineering Ingegneria Informatica S.p.A., the first IT group in Italy and among the top 10 IT groups in Europe, and Ro Technology S.R.L., an innovative SME which designs, develops, and validates applications, tools, firmware and hardware components for several markets.

One of the objectives of this project has been the development of a series of advanced dashboard systems. Their aim is to provide a 360-degree integrated view on every aspect of Maccarese's operations, and to provide decision support in the measure of suggestions that can be readily implemented by the management. Three macro-areas have been identified, and the same number of Decision Support Systems (DSS) has been developed. Specifically:

- Animal Welfare Decision Support System (DSS): provides the breeder with important indicators related to animal welfare (i.e., prediction of pathologies such as lameness, mastitis, ketosis and environmental stress). A breakdown of health statuses for each cow and tracked pathology is provided, together with integrated insights. Moreover, the dashboard offers suggestions on corrective actions that the farmer can choose to enact immediately.
- Estimate Milk Quality Dashboard: through a combination of the analyses performed at the milking stage, intertwined with data on animal health and activity, farmers are provided with a prediction of the quality of the milk produced
- Benchmarking System: building on the enormous quantities of historical data gathered by Maccarese throughout the years, a benchmark comparison with the baseline data is shown in terms of indicators such as milk yield by cow, milk total yield, milk quality, cow health, nutrition and company productivity. All of this is related with a set of target values (i.e., average and optimal indicator values from similar/neighbour companies).



Figure 8. Decision Support System Dashboard

Continuous Improvement through Research

One of the core principles that are embodied in every activity of Maccaresse S.p.A. is the importance that education has in its field. Education in the agricultural world does not mean only learning how to employ advanced technologies and processes to rise efficiency and profits, but also how to leverage scientific advantages to reach a good sustainability equilibrium. The firm, a leader for what concerns advanced agricultural technologies and processes, strongly believes that it is his moral duty to share the knowledge that results with all its investments and research, in order to create a new class of farmers.

In 2018, the firm gave physical form to this belief, by constituting the “*Polo di Formazione per lo Sviluppo Zootecnico*”, an educational centre for the advancement of zootechnics, that leverages Maccaresse’s infrastructure and expertise with a network of renowned partners that operate in the management and research and development of the zootechnics area. Out of them, the most relevant are category associations such as Coldiretti and AIA (Associazione Italiana Allevatori), scientific partners such as CREA² and University of Viterbo, leader institutions in the zootechnic area in Italy and leading multi-national companies such as John Deere and New Holland. Moreover, it has built a faculty with professors and scholars from universities such as Cornell University. The main aspects around which the lessons and research of the Centre revolve are animal welfare, environment preservation, sustainable usage of agrochemicals and precision farming³. The centre operates with a Scientific Committee composed by faculty members from renowned international universities, that facilitate the transfer of knowledge between researchers and managers towards farmers that want to embrace agriculture 4.0. Strong throughout all the courses is the relevance that is given to the role of data, already fundamental at Maccaresse, and that is a common starting point for all the lectures that are imparted.

Consistent with the give-back principles that permeate Maccaresse, the Centre is no-profit: the firm leverages its knowledge, experience and expertise, and its strong network of partners, to benefit other farms and thus society as a whole, promoting sustainable ideals and the belief that the environment has to be respected. The agri-zootechnic managers of the future cannot be so without sharing these beliefs: Maccaresse is already far advanced on the path, and is more than glad to share all of this to facilitate making the farming world more advanced.

2. Consiglio per la Ricerca in Agricoltura e l’Analisi dell’Economia Agraria (*Council for Agricultural Research and Economics*), Italy’s leading Italian research organization dedicated to the agri-food supply chains, supervised by the Italian Ministry of Agricultural, Food, Forestry and Tourism Policies (Mipaaf) <https://www.crea.gov.it/>.
3. http://www.poloformazionemaccaresse.it/public/PDF/BII_2018_59112672_44_IZ%2018-2018%20Economia%20Maccaresse%20Saggio%20pagg%2044-47.pdf.

Another aspect that reflects Maccarese's interest towards research and education is its historical archive, named after Carlo Benetton, and how it maintains it. More than 500 meters long, it contains the entire documentation produced by the company from the end of the 1920s to the 1990s. Its relevance stands not only in the documents about the company, the historical productions and the farm work, but also in the fact that it contains information on the social and economic history of the territory and the community that revolves around the farm.

In particular, vast data is available not only on strategic choices concerning cultivations and farming, but also on all the managerial decisions and their results, also in terms of yield, throughout the better part of a century. In addition to that, it contains all the information about the relationship with the population of the Maccarese area, and about all the infrastructure and services that was created for the local community. It houses, among others, around 165 volumes, 1.750 registers, 2.400 envelopes, 51 boxes of pictures and tables. Once again highlighting the propensity of the firm to make all its resources available outside, it is part of the archival network Lazio'900, has adopted a digital catalogue and has organised research programs through which scholars can request access to the entirety of the documentation. It is not only a testimony on the history of one of the most relevant farming realities of the entire country, but also a historic memory of Italy and Latium as a whole.

The educational aspect is not only reserved to higher education institutions, scholars and other farms. Within its continued effort to share its knowledge and improve society as a whole thanks to it, for years Maccarese has been host to various school visits. In these occasions, students and children have the chance to learn how such an important component of our primary sector works, and in addition to that, experience first-hand how innovation and modern managerial techniques and processes can make what is thought to be a traditional enterprise strive.

Social Impact & People Culture

“Maccarese S.p.A. goal is not only to be one of the best farming realities in Italy. It is to get there while being a socially responsible, environment-friendly company that treats its animals responsibly and that cares first and foremost about the wellbeing of its people and the reality where it is located” as Mr. Benetton said.

While the firm strongly believes that the best output and the best performances can be achieved only by leveraging good animal conditions and people that are motivated and satisfied, this is not the reason why it has embarked in this endeavour. It knows in its heart, and facts demonstrate it, that it is the right thing to do, towards people, towards society, towards animals and towards the planet as a whole.

Specifically, many of the elements discussed above, from energy-saving measures to the constant monitoring of animal health, highlight the relevance of the efforts that are being made towards sustainability, energy efficiency and animal well-being.

The territory on which Maccarese is located is enormous, and has some unique properties and characteristics of natural and environmental relevance, also thanks to it being quite close to the sea.

The Mediterranean scrub is divided in two parts by the inhabited parts of the municipality of Fregene, and extends for more than 400 hectares next to the sea. On it three separate oases are located, characterised by vegetation that is both of high and low varieties. Because of their unique characteristics and strategic location, they have become a location for stop and rest for many species of birds, such as marsh harriers, hen harriers, ducks, cuckoos, and hoopoes. They are also inhabited by a variety of animals, such as badgers, porcupines, wild rabbits, hedgehogs, and foxes. Another area is destined to terrestrial tortoises.

Maccarese is keen on establishing partnership with external entities, to leverage their expertise and give access to its natural resources and peculiarities not only to researchers and scholars but also to the general population. With this scope, the entire Mediterranean Scrub area, is managed by the World Wildlife Fund (WWF), which has established four separate nature reserves that are open to the public and to guided tours.

The area also contains 36 hectares of fishponds, constructed in 1970 to experiment on fish breeding. The project was not very successful, leading to the abandonment of the ponds: this laid the foundation for the birth of a unique biotype of wetland, characterised by atrophic features. The oxygen in the waters of the area is scarce enough to incentivise the presence of numerous species of animals.

In addition to that, a 50 hectares plant nursery is present on the company's grounds. Established to produce plants both for ground plantation and for potting, it was abandoned after failing to achieve a good output. It has been completely reclaimed and rendered accessible, and has a very high natural relevance because of the many varieties of plants present.

Concerning the infrastructure that is present on the land, much has historic relevance, and has been duly restored by the company to fulfil its duty to its community and to Society as a whole. For example, the Castle of San Giorgio [Figure 9], a centuries-old castle with Norman origins, was completely restored in the past years with an effort by Maccarese: it is now open to the public and is used by both the company and the municipality for official events.

In the words of the President, *“while nature is part of the soul of the company, it is the people that are at the centre. Maccarese prides itself to be a modern, young company, that believes in hiring people with strong values and that recognise the same values in the firm itself”*. The number of employees in 2019 is 86, with an average age of 38. While the majority of these employees are categorised as manual workers, taking care of all the labour that is required in a farm, the company invest in training to go beyond the traditional tasks that are expected of workers in similar realities. The efficiency translates into a significant benefit to its employees, as they are empowered and can keep developing themselves. Another aspect that the historically characterize the firm is gender equality. This is deeply rooted in its past, as the management had established equal pay



Figure 9. Castello di San Giorgio

in 1961, mirroring the values that Maccarese acts with every day: workers are equal, have the same rights, the exact same duties and the exact same salary, regardless of gender.

In addition to that, Maccarese is a very active member of its community, as part of its giving back efforts. In addition to having restored the aforementioned Castle of San Giorgio, and given access to the public, it has been contributing to the well-being of the municipality of Maccarese for years, with actions such as restoring and maintaining its green areas, in order to demonstrate the strong correlation between a good living and respecting nature.

Moreover, in July 2021, Maccarese has changed its judicial status to *Società Benefit*, Benefit corporation. This status, recognized in various countries around the world, is an adoption choice made by for-profit companies that decide to go beyond the goal of only pursuing profit, but instead decide to strive for the common good, operating in a way that is responsible, sustainable and transparent towards people, territories and the environment.

Adhering to all of this is voluntary, but Maccarese has modified its charter to include principles that aim towards the welfare of the community, of its people and of the territory where it's located, and to bound itself and its management to them. It's important to underline the fact that, while the benefit corporation status adds officiality to these behaviours, they have been intrinsic in everything the firm has done and has believed in since the inception of its modern era. They can be seen as re-affirming and summarising the core of what Maccarese S.p.A. is.

These principles rotate around the following areas:

- Promotion of agricultural practices that are particularly attentive about the territory and about preserving the environment, such as re-cycling materials that originate from zoo-technic activities to produce electricity, or pursuing efficiency with the aim of reducing waste and respecting the environment
- Valorisation of areas with high naturalistic value, together with the maintenance and preservation of the green areas of the municipality of Maccarese and a partnership with WWF, with the aim of making visitors understand that nature contributes to the general well-being of communities and territories.
- Restauration, promotion, and usage of cultural-historic sites that belong to the firm, such as the Castle of Maccarese, with the aim of making them available to scholars and to the public.
- Creation of educational initiatives around new agricultural technologies and research, through the development of an agri-zootechnic educational hub, incentivising collaborations, and partnerships with universities, professional schools, and other farming realities.

Moreover, AGCM⁴, the Italian Competition Authority has recognized the high moral standing of the firm by granting it a two-star plus legality rating, which is reserved to virtuous companies that operate under the principles of lawfulness, transparency, ethics, and social responsibility. In addition to that, in July 2021 the United Nations have granted Maccarese's request to become part of the Global Compact, a UN Network of thousands of responsible businesses in more than 100 countries that want to uphold a strong commitment in the areas of human rights, labour, environment and anti-corruption, proceeding towards the Sustainable Development Goals. Maccarese is now among companies such as Nestle and Loacker, and it also the first agricultural company that is part of this network.

4. Autorità Garante della Concorrenza e del Mercato

Competitive Situation and Market Structure

The Italian milk supply chain, in which Maccarese operates, is composed of multiple actors, as per Figure 10.

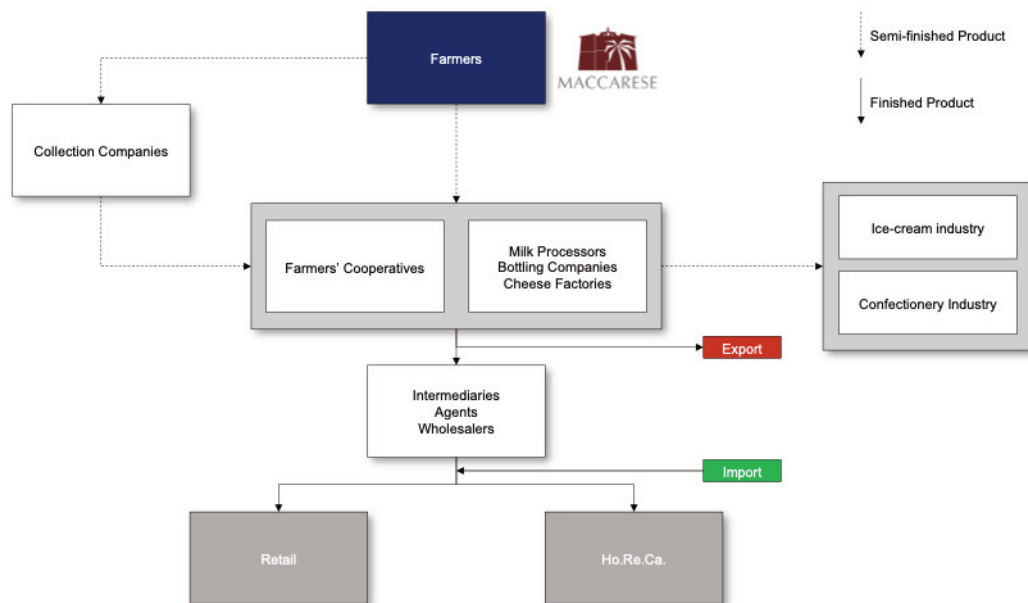


Figure 10. Italian Milk Supply Chain

Maccarese S.p.A. positions itself at the top of the chain, as a producer. It exists in the ecosystem of the Italian milk production sector, which constitutes of around 27.000 companies of various sizes, and of approximately 1.7 million milk cows. It is important to clarify that all these figures, and the competitive environment in which Maccarese is situated, refer only to cow milk, and do not take into consideration milk from other animals such as sheep, or vegetal milk. Data from 2018 shows that the Italian production of cow milk amounted to 11,7 billion litres per year, with a 5-year CAGR of 2,2%. This production is particularly concentrated in northern Italy: the regions of Lombardy, Emilia Romagna, Veneto and Piemonte contribute to around 78% of the entire figure. Latium, where Maccarese is located, on the other hand is home to around 2,7% of the national production with 316 million litres per year. The milk market in Latium is quite fractionated, as around 920 are part of it. Nevertheless, with its output the company amounts to 5,2% of the region's entire produced quantity.

Finally, in order to achieve a great understanding of the competitive situation in which Maccarese operates, it is important to have a look at who the company perceives its competitors are: Genagricola, and Gruppo Bonifiche Ferraresi.

Genagricola is a holding company belonging to the Italian insurance group Assicurazioni Generali. It represents the largest agricultural group of the country in terms of land extension. Founded in 1851, it is formed by 28 wholly owned companies, 26 of which are based in Italy and 2 in Romania. It amounts to 13.000 hectares of farmland: 8.000 in Italy, in the regions of Piemonte, Lombardy, Veneto, Friuli-Venezia Giulia, Emilia Romagna, Latium and Calabria, and 5 in Romania. Its operations are distributed between winegrowing, breeding, renewable energies and cultivation of fodder and cereals, maintained by around 500 employees depending on the season. Its revenue was €56M in 2018, with an EBITDA of €0.7M and a Net loss of €0.6M due to €4.7 M of amortisation.

Gruppo Bonifiche Ferraresi, on the other hand, through its holding B.F. S.p.A., is involved in farming, seeding production and cultivation, together with the distribution of the products of these efforts. There are three main companies that are part of the holding. Bonifiche Ferraresi leverages 6.500 hectares of land to cultivate vegetables and fruit that are sold directly to end customers, to breed cows and to produce raw materials for agriculture, that are mostly sold to its sister company BF Agro-industriale. The latter focuses on purchasing, producing, and commercialising packaged goods both via brands that are owned by the group, such as “Le Stagioni d’Italia”, and through private labels, mostly towards large-scale distribution. Società Italiana Sementi is instead focused on seeds. It is important to note that CDP Equity, a fund belonging to Cassa Depositi e Prestiti (CdP), the Italian National Promotional Institution, owns 24,5% of the holding’s shares. It had a consolidated revenue of €78.6M, the EBITDA was €4.8M and the net profit was €0.1M with €2.6M of prepaid taxes and €5.5M of amortisation.

Future Developments

Maccarese S.p.A. has adopted not only advanced and efficient technologies, but also a growth-oriented people mindset, and a fair, respectful stance towards animals and nature. These synergistic approaches merge together in one desired strategic output: higher milk quality. The question is how can all these elements become a value factor, not only to the direct customers of the Firm, the companies that transform milk, but also to the end customers as well? How can these quality dimensions be transferred along the entire supply chain, so that a customer can transparently decide to want the higher quality milk that comes from Maccarese?

To get a clearer picture, it is important to understand what the end-products in which milk is transformed are, and how consumers see them. Cheese and Yogurts, for example, are quite sought-after, and consumers can be seen to pay a premium to buy certain brands, origins, or specific quality features. Milk, on the other hand, could be perceived more like a commodity: customers could be considered not to be interested in knowing exactly how the animals that produced this milk were treated, where exactly it was produced. And even if they were, this information is rarely available.

This happens because of many reasons, but one of them is that transformation companies have limited interest in making one milk producer's output more valuable than someone else's: if all milk is equal, then there is no differential value is associated to their product, moving the value-chain bargaining power towards the transformers.

Net, all the information that Maccarese gathers, the complexity of its processes and the quality of its products, signalling different typology of milk, get lost before getting to the end customer. And even if they got to these customers, it is not certain that they would be able to understand what this information means, and how to use it to buy products that are not only better and healthier, but also more respectful of animals and of the environment.

Moreover, in order for all this information to be actually usable and differentiating, it has to be certified, so that only producers that actually employ quality techniques can claim to do so.

One of the possible solutions for the problem is the adoption of Blockchain technology, which is more and more used in the food sector.

All the data about animals and processes produced by the farm could be stored on it, in order to expose all the parts of their supply chain and make them immutable and certified. End customers, moreover, would be able to scan with their phones a QR code on the milk pack, and access all the aforementioned data, experiencing first-hand the transparent approach of the company.

Core Questions

The management is thus confronted with the alternative solution to invest in this blockchain technology, that requires an investment not only in terms of money, but also in terms of training and resources, and that could help solving this issue. In addition, would the investment also be valuable to communicate the efforts of Maccarese in terms of Corporate Social Responsibility? In order for Maccarese to make the right decisions, Andrea Benetton, its President, and Claudio Destro, the CEO, together with Matteo Boggian, the manager responsible for the zootechnic sector, and the entirety of the Management Team, have been asking themselves a series of questions about the project, its feasibility, and the advantages for the company.

- What changes would it cause in the market structure? And in the way partners such as producers, transformers, distributors interact with each other?
- Which impact would the implementation have on the entire supply chain?
- What would the impact on consumers be? What would they value in terms of benefits? How would it be possible to make them take advantage of all this information? Which kinds of customers would be more interested in the product?
- What is the impact that an investment such as this could have on Corporate Social Responsibility, and on its communication outside of the company? What could be the dynamic between CSR and blockchain-certified processes and information?

And, in conclusion:

- Should Maccarese invest on the project? Or should it explore alternative solutions to the issues? If so, which ones?

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