Università
Ca'Foscari
Venezia

Master's degree in Management

Innovation and Marketing

Final Thesis

Digital transformation of the agri-food sector: a sustainability focus

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Matriculation Number 885828

Academic Year

2021/2022

Acknowledgments

Before proceeding with the discussion, I would like to dedicate a few lines to all who have been close to me in this personal and professional growth journey.

A special thank you to my supervisor Christine Mauracher for her endless helpfulness and for providing me with useful advice and material for writing the thesis. Thank you also for having heightened my curiosity about the marketing behind the agri-food sector.

Thanks to the Agri-food Management & Innovation Lab of Ca' Foscari for giving me the chance to collaborate with the team to do research useful for my thesis and hopefully for the compartment.

I would like to thank all the staff of the company +Watt, where I did the internship, for their hospitality and for the skills acquired in the field.

I thank my parents, my brother and Alberto, my sister and Federico, from the bottom of my heart who have always supported me, backing my every decision, ever since I chose my course of study.

I thank my girlfriend Lisa for passing on her strength and courage to me. Thank you for all the time you have given me. Thank you for always being there.

Thank you to my friends for giving me carefree moments even in the most difficult times.

Finally, I dedicate this thesis to myself and to my sacrifices and tenacity that have allowed me to get this far.

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Introduction

Nowadays, environmental sustainability is one of the most relevant topics that should have the role of ruling most of the economic, social, and political decisions but in many cases do not. I would like to emphasize nowadays because, even if environmental sustainability is an "old" concept, it is still a controversial matter.

We are living in a dynamic world, where innovation runs fast, and the discovery of new technologies is every year growing. Never more than now, there is the need and there are tools to mitigate the adverse effect of climate change and, therefore, increase the competitiveness of companies that act responsibly. Moreover, the needs of consumers changed drastically compared to the past, facing consumers who are attentive to the quality of the food, where it comes from, that it is traceable, and that it has been produced in accordance with sustainability criteria. These are all interconnected factors that companies in the sector must necessarily comply with in order to cope with the new trends.

These are also consequences related to recent events that have undoubtedly shaken the industry namely covid 19 and the current Ukraine-Russia war. Overall, it can be said that Covid-19 has benefited the industry by giving an incentive to innovate and, consequently, digitize. It is clear that an event of this magnitude brings imbalances and uncertainties. Instead, the conflict in Ukraine is wreaking great havoc on the sector by raising the cost of raw materials and consequently the finished product and jeopardizing food security.

Some of the tools and strategies useful to face current issues and new trends are smart technologies and digital marketing.
It is difficult to give a precise definition of smart technologies but, in general terms, are often used to refer to any form of technology that is now accessible and enables users to connect to internet networks (Papadopoulou & Maniou, 2021). I concentrate my research on the three main categories: Internet of Things, Big Data Analysis, and Cloud Computing. Digital Marketing refers to all those activities of promoting a brand and marketing products and services through one or more digital channels. My focus is primarily on social media marketing, newsletter marketing, and SEM strategy since they are the most used tools used by companies in this sector.

The focus of this thesis is on the digitalization and sustainability of agri-food marketing with the aim to demonstrate how digital innovation could face, or, in the best-case scenario, solve the challenges of the agri-food sector. My intent is also to understand how much consumers pay attention to environmentally friendly products. Consequently, how digital marketing can make a difference by, for instance, influencing the choice of consumers and directing them to purchase more sustainable products and why, in some cases, failing to do so.

The thesis is structured as follows.

In the first chapter, I illustrate the challenges of the agri-food sector. First, how much the compart is accountable for climate change, second, how Covid-19 impacted, and finally the recent rise of the Ukraine war and its consequences.

In the second chapter, I illustrated how the advent of Agriculture 4.0 has led to the digitization of the agribusiness sector and consequently the advent of smart technologies. I then explained the three main categories of smart technologies and how they can bring efficiency and effectiveness, especially through their interconnection with the concept of sustainability.

In the third chapter, I explained the concept of digital marketing, the smart technologies used in this field in order to enhance the correlation throughout the supply chain, and why digital presence is fundamental to being competitive.

The last chapter is about the empirical analysis conducted based on the literature reviewed, carried out with a funnel strategy of a qualitative analysis. Starting from the analysis desk conducted on a sample of companies, then, it has been submitted to those companies a survey in order to understand the level of digital transformation and sustainability and, finally, I conducted in-depth interviews with companies that I would like to focus on particularly.

Chapter 1 "Recent trends of the Agri-Food industry"

1.1. An overview of the challenges in the agri-food sector

The agricultural industry is currently dealing with several problems in order to respond to the global population increase in a sustainable manner and address concerns such as climate change, resource exhaustion, food safety, wasteland, labor exploitation, and pesticide run-off. This situation results in several sustainability threats related to energy, materials, and water usage, as well as greenhouse gas emissions, making agri-food the industrial sector with the greatest environmental effect (Latino et al., 2021a). According to the Intergovernal Panel on Climate Change's (IPCC) Fifth Assessment Report (AR5), '*Ca. 25-30% of total GHG emissions are attributable to the food system. These are from agriculture and land use, storage, transport, packaging, processing, retail, and consumption.*'

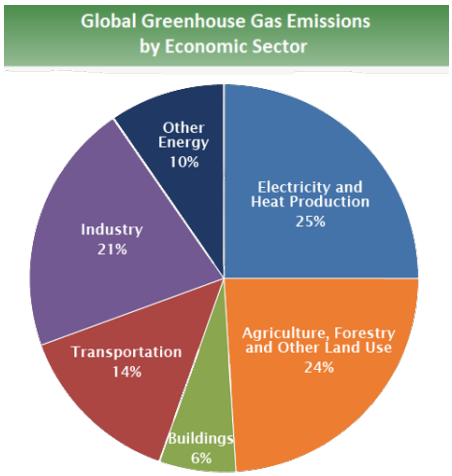

Figure 1 - Exit based on global emissions from 2010. Details about the sources included in these estimates can be found in the *Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change,* Source: IPCC, 2014

The United Nations (UN) addressed the most pressing issue in 2015 with its 2030 agenda for sustainable development, attempting to recommend corrective steps in order to solve the global worry over hunger, which has been plaguing the globe for years. However, meeting this goal remains a long way off: over 800 million people globally suffer from

hunger, with 650 million of them remaining undernourished by 2030. It is necessary to produce 70% more food by 2050, while agriculture's contribution to global Gross Domestic Product has dropped to only 3%. Between now and 2050, there may be a net 2.4 billion people added to urban areas as a result of global urbanization. Infrastructure developments like cold chains, which allow for the sale of perishable products, are sparked by urbanization. As part of a wider nutritional change, it also has a tendency to increase earnings, raising demand for processed foods as well as food derived from animals. The expected increase in annual per capita meat consumption from 36.4 kg in 1997–1999 to 45.3 kg in 2030 (de Clercq et al., 2018). However, there are drawbacks to richer diets, particularly the overeating of meat. In developed countries, there is an excess of childhood obesity and a startling number of people with chronic diseases including diabetes, high blood pressure, and heart issues as a result of a shortage of fresh meals, a reliance on fast foods (many of which are meat-based), and processed foods. Indeed, infectious illnesses, which continue to be the main cause of sickness in poor nations, add to the double burden of chronic disease, which accounts for about half of the global burden of disease (Kaneda, 2006). The repercussions of higher meat production on the environment are equally significant: an estimated 18 percent of greenhouse gas emissions created by humans come from the production of cattle, which uses close to one-fourth of all the water used in agriculture worldwide. The environmental effect is unsustainable in the long run.

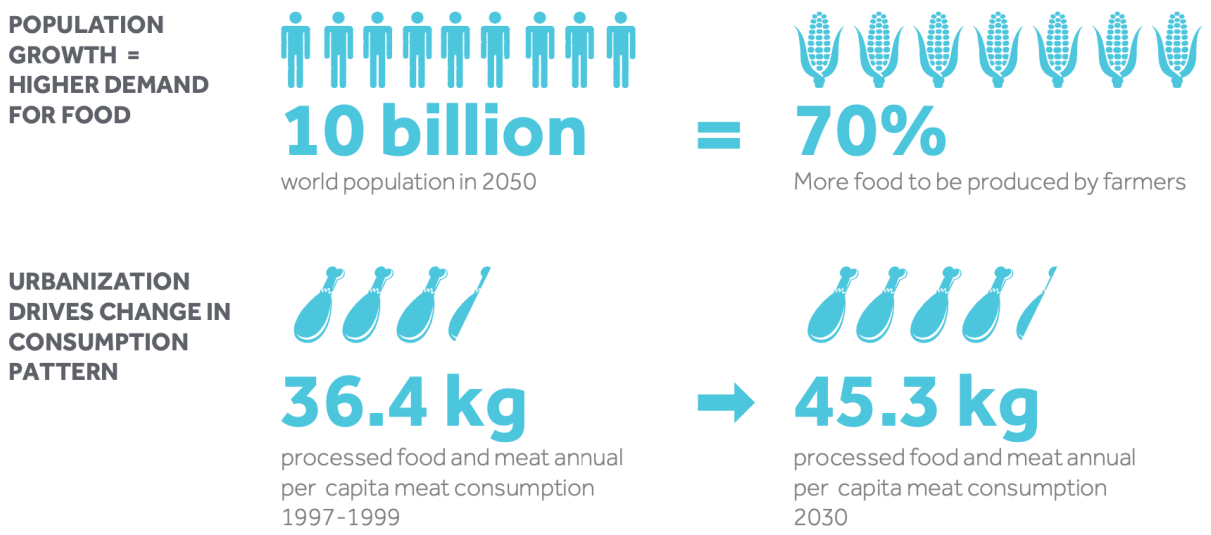

Figure 2 – Demographics, Source: de Clercq et al., 2018

While the need for larger quantities of food is increasing, concerns about food fraud and safety have emerged (Banerjee & Hysjulien, 2018), compelling the agri-food industry to rely on food safety as well as eliminating the communication gap across farm owners and customers (Hahn, 2012).

The agriculture industry is facing increasing worldwide competition, and some developed nations appear to be responding by doing more of the same. Firms have decreased in size over the years and have grown more concerned about production efficiency, cost-cutting, and economies of scale (Alston, 2018). On a broad scale, this expansion would enhance animal production, and promote cultivated area and irrigation, resulting in more goods transport. From a sustainability point of view, it's debatable whether this approach will be able to address the global difficulties that lie ahead (Barth et al., 2021).

Any considerable growth in food production must be socially and sustainably accountable, meeting both production and sustainability objectives, to prevent potentially disastrous repercussions (Hunter et al., 2017). The development of new knowledge and its exploitation through innovation is the common approach to implementing new methods and advances in sustainability (Neutzling et al., 2018a). Each sector in a country can benefit from innovation through a strategic approach to increasing productivity (Damiano Petruzzella & Angelo Di Mambro, 2017).

1.1.2. The impact of Covid-19: issues and opportunities

The pandemic caused by Covid-19 is having a previously unseen economic impact on the global economy. Coronavirus has transformed global food production and consumption, affecting the agri-food industry. This sector includes a wide variety of operations, from the initial transformation of animal and vegetable raw materials to the creation of complex goods (Martínez-Azúa et al., 2021).

With the commencement of the pandemic, global supply chains failed to encounter product demand due to their volatility and lack of organizational resilience (Sarkis, 2020). As a result, the effects of turbulence and resonance extend across worldwide networks as demand and supply variations (Guan et al., 2020). In order to

explain why global supply chains fail, it is fundamental to look at the lack of flexibility, visibility, and resilience (Bag et al., 2021).

Moreover, the epidemic has brought the entire planet to a pause, delaying the acceptance or accomplishment of the Sustainable Development Goals (SDGs) (Gulseven et al., 2020). In September 2015, the United Nations approved the 17 SDGs to address these sorts of concerns in global sustainable development (Modgil et al., 2020). Economic, environmental, and social dimensions are all linked in the SDGs, which is an umbrella structure for a sustainable supply chain (SSC). Thereby, there are three main components of SSC practices: sustainable supplier management, sustainable operations, and risk management, and finally pressure and incentive management (Zimon et al., 2020).

SDGs may be met through expanding the use of circular economy (CE) concepts throughout the location and economy using these practices (Kayikci et al., 2021).

Due to a major worldwide economic shutdown, uncertainty, and uncertainties about the future, global financial markets crashed in the first quarter of 2020. In particular, an online search for COVID-19 and its impact returns 4,280,000,000 results, with 68% indicating effects on enterprises, the economy, and industries such as the agri-food sector. As a result, these effects are reflected in several SDGs such as SDG 1 (No Poverty), SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-Being), SDG 4 (Quality Education), SDG 5 (Gender Quality), SDG 8 (Decent Work and Economic Growth), SDG 10 (Reduced Inequalities) and SDG 16 (Peace, Justice and Strong Institutions) (Leal Filho et al., 2020). The implications of the coronavirus outbreak highlight the need for sustainability as well as a transformation of global business practices in the digital age; hence, smart circular supply chains (SCSC) should play a bigger role in addressing the UN's SDG goals (Pan & Zhang, 2020). As a result, SCSC may minimize resource loops for materials to reduce COVID-19 shortages by promoting smart circular practices with technological improvements and plans for long-term supply chain sustainability and overall supply chain resilience (Kayikci et al., 2021).

As a matter of fact, the provided economic statistics show that the agri-food industry has been one of the less afflicted by the pandemic crisis. The gross added value of the primary sector increased by 3.6 % quarter-on-quarter (6.3% year-on-year) in the second half of 2020, according to statistics from the 2020 Agri-food Sector Report, with a significant rise

in the number of necessary commodities. The primary sector's influence on the economy grew, providing 3.8 % of the GDP, up 1.1% from 2019 (Martínez-Azúa et al., 2021).

According to some business analysts, COVID-19 has brought about five changes that will have long-term consequences from a macroeconomic perspective (Carrasco et al., 2022). To begin with, the shift to a so-called Digital Economy: people are being forced to connect and work online due to constraints on in-person interaction (BDO, 2022). Secondly, border activity has slowed because of the coronavirus, which has obstructed commerce and other border activities. This has impacted airlines and tourism the most (Makhiboroda et al., 2020). Furthermore, the education field that relies on overseas student tuition payments would be impacted in several nations (Martínez-Azúa et al., 2021). Thirdly, governmental authorities will play a larger role and will face more pressure to make changes. The economic impact of the outbreak will result in increased demand for public services, particularly in terms of financial assistance to the jobless or enterprises. Moreover, it also brings up the issue of public vs. private healthcare (OECD, 2020). The fourth change put a stronger emphasis on crisis response and recovery. Many people have faced difficulties and this allows to recognize how critical it is to have public authorities that can lead the recovery (BOL et al., 2021). To conclude, the last change is related to the pressure on the economy; governments have announced more stimulus packages than they did during the financial crisis of 2008.

A further point worth mentioning is the pandemic's worldwide reaction, which has accelerated a number of trends that have stimulated creativity and innovation across all industries as they look for answers to the changes in different sectors. Consequently, for the academic field, enterprises, households, and entertainment, teleconferences and webinars offer alternatives to social isolation and limitation (Martínez-Azúa et al., 2021). The interchange of information, particularly the Internet of Things (IoT) in business-to-consumer (B2C) and business-to-business (B2B) enterprises, is one of the most crucial, complicated, and wide-ranging phenomena (Feng, 2020).

Finally, customer behavior has changed in various areas, including the way of working, the use of leisure time, and the purchase method (Martínez-Azúa et al., 2021). Generations with less established behaviors are leading the way in changing the world: the "millennials" and "Z" generation. In reaction to recent technological advancements, the crisis has occurred at a time when radical changes are occurring in how people engage

with the different typologies of media. As a result, this pandemic is likely to have a more profound influence on consumer behavior than prior crises (Bona et al., 2020).

1.1.3. The impact of the Ukraine-Russia war

Besides COVID-19, on 24 February 2022, another significant event emerged: Russia decided to invade Ukraine. This caused a considerable loss of life and property. As a matter of fact, the conflict has evidently created a significant and deteriorating food security crisis in Ukraine, interrupted lives throughout the agricultural growing season, and damaged global food security. As the war progresses, it is unclear whether Ukraine will be able to harvest current crops, grow new ones, or maintain animal husbandry. Port closures, the stoppage of oilseed crushing operations, and the imposition of export license restrictions and prohibitions for specific commodities and food goods have all resulted from the conflict. Key cities are being surrounded and continue to be bombarded, isolating people and leaving them with acute food, water, and electricity shortages. People are expected to slip deeper into emergency levels of hunger and malnutrition if insecurity prevails and both local and national food systems are interrupted (Food and Agriculture Organization of the United Nations, 2022).

In accordance with European Union's statistics, 35,7% of Ukraine's imported goods to the EU are agricultural products. In the EU, Ukraine contributes for 4.6% of all agri-food imports. Regarding exports to Ukraine, instead, the EU sells 12.4% of its agricultural products to the country.

Cereals, animal and vegetable fats and oils, oilseeds, food industry leftovers and waste, edible fruits and nuts, and meat and edible meat offal are the primary items imported from Ukraine. Beverages, tobacco, dairy products, cocoa, culinary preparations, food industry wastes and trash, and oilseeds are the most common EU exports to Ukraine.

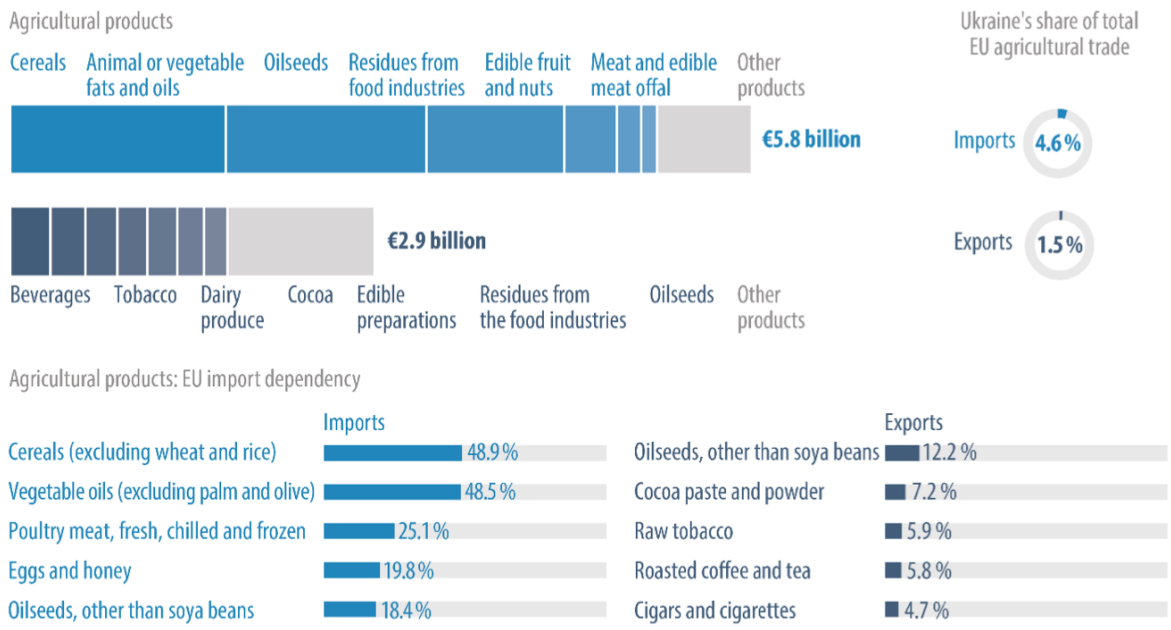

Figure 3 - EU trade with Ukraine: Agricultural trade by product (2020). Source: European Union, 2022

Ukraine provides over half of the EU's grains and vegetable oils, as well as more than a quarter of its chicken meat. Ukraine imports oilseeds, cocoa paste and powder, raw tobacco, roasted coffee and tea, and cigars and cigarettes from the EU. Sunflower seeds, corn, wheat, and meslin dominated Ukraine's worldwide agri-food exports in 2020 (Sabbati & Vinci, 2022).

Worldwide food costs had already touched an all-time high prior to the Ukraine conflict. This was attributable mostly to market dynamics, but also to high energy, fertilizer, and other agricultural services expenses. The FAO Food Price Index set a new historical high in February 2022, up 21% from a year earlier and 2.2 % from its previous high in February 2011. In fact, from an international commerce standpoint, the Russian Federation and Ukraine play an increasingly important role in global agriculture. Agricultural products from both countries are exported at a high rate, and they both supply a large portion of the world's food supply, which is often centralized in a few countries, making them vulnerable to shocks and volatility. Russia is the world's largest wheat exporter, delivering 32.9 million tonnes (in product weight) of wheat and meslin, or 18 percent of global shipments. With 20 million tonnes of wheat and meslin exported in 2021, Ukraine ranked sixth in the world's wheat exports and had a 10 percent market share.

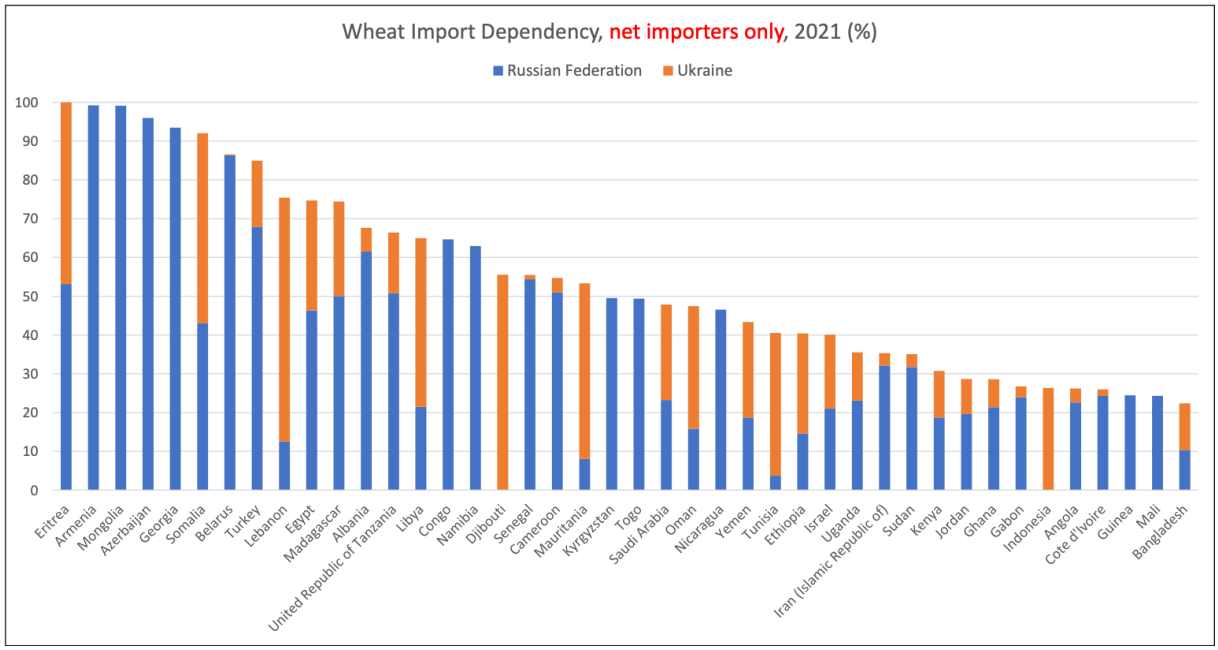

Figure 4 - Wheat Import Dependency, net importers only, 2021 (%) Source: Food and Agriculture Organization of the United Nations, 2022

Therefore, concerns about the crisis in Ukraine's possible impact on food security, both locally and globally, are growing. Locally, the escalation might directly reduce agricultural productivity, which, when combined with limited economic activity and rising prices, could erode local communities' buying power. Internationally, if either country's food exports are cut off abruptly and for an extended period of time, the conflict might put extra upward pressure on world food commodity prices, hurting especially low-income food-deficit countries (Food and Agriculture Organization of the United Nations, 2022).

1.2. Innovation and sustainability in the agri-food industry as an efficiency booster

A central concern about achieving agri-food challenges is reconfiguring agri-food systems towards sustainability and innovation (Caron et al., 2018). To achieve this transition, this sector needs to encourage disruption and systemic innovation (Tilman & Clark, 2015). Innovation, whether it be technological, organizational, institutional, or marketing, is necessary to improve sustainability across all sectors. Innovation has always been a priority for the agricultural and food sciences sectors. For example, research focused on

agriculture aids in offering farmers, engineers, and advisors alternatives for crop-soil management strategies aimed at boosting crop yields, decreasing loss threats, and decreasing the environmental effects of agriculture (Tilman & Clark, 2015), whilst research focusing on food aids food producers in exploring new methods of formulation, preservation, processing, or packaging for food (Villemejane et al., 2013).

A reconnection between the innovation processes occurring within the agricultural and food sectors is suggested in the hopes of addressing sustainability challenges and limiting the power disparity between stakeholders, even if innovation is still mostly controlled independently within each domain today (J.-M. Meynard et al., 2017). Therefore, a new challenge is to connect innovation mechanisms in agronomy and food engineering to take advantage from different points of view.

Nevertheless, it was assumed that it is impossible to achieve sustainability without assuring resilience (Volkov et al., 2022). Originally, the major focus of agricultural resilience was on natural disaster adaptation and resistance. The additional dimension has been considered, though. For example, in addition to economic data, agricultural resilience analysis has been expanded to include social (Davies et al., 2009) and environmental (Milestad & Hadatsch, 2003) variables. Agricultural resilience has received attention, and it has been suggested that economic resilience also makes it possible to take advantage of social and environmental benefits (Shadbolt et al., 2017). It has been demonstrated that greater specialization is linked to better mean results, but greater return volatility also seems to suggest diminished resilience (Abson et al., 2013). Crop structure diversity has also been considered a requirement for agricultural resilience (Birthal & Hazrana, 2019). It has been discovered that resilience may be achieved without sacrificing economic effectiveness or agricultural output in general (Komarek, 2018). There have been conflicting conclusions about the existence of economic costs related to resilience enhancements (Chelleri et al., 2015).

Economic resilience was estimated by (Quendler & Morkūnas, 2020), who brought attention to passive resistance. (Lamichhane et al., 2020), who demonstrated the significance of economic factors in the framework of agricultural resilience, emphasized the significance of the economic part of the resilience notion. Adaptive managing techniques were mentioned in relation to agricultural resilience by (Rey et al., 2017). Insurance policies were suggested by (E Ayinde et al., 2020) as a potential means of

boosting agricultural resilience. When evaluating the ability of agricultural systems to evolve, agricultural resilience emerges as an important notion (Gardner, 2019; Kazandjiev, 2017). A comparable strategy in this respect is climate-smart agriculture (Makate et al., 2019). Resilience threshold, together with environmental and social variables, is the main concern in the context of climate-smart agriculture (Joshi et al., 2019). In order to avoid leaving out crucial external influences, (Rathi, 2022) broadened the agricultural resilience framework to include the entire rural sector. The resilience-based approach has been suggested for use in agriculture as a strategy to meet social needs (Ge et al., 2016). Additionally, the promotion of conservation agriculture methods is crucial but it is important as well to introduce new technologies and techniques as a way to improve resilience (Jiménez & Ramírez Villegas, 2018).

The creation of new information and its exploitation through innovations are the main tools for applying new techniques and advancements, which are necessary for sustainability (Neutzling et al., 2018b). Innovation is a crucial strategic component for raising a nation's overall productivity across all sectors (Petruzzella & di Mambro, 2017). There is evidence that the percentage of agriculture research and development affects total sector productivity in favorable ways (Alston et al., 2010). With nations' improving economic performance, expenditures in innovation are also advantageous for enhancing the agri-food industry's positive externality (de Castro et al., 2011).

1.2.1. Open innovation and Sustainability

The relevant research demonstrated how open innovation (OI) tactics are more likely to be used in the agri-food sector in the digital age (Santoro et al., 2017). In this way, digital technologies become a key factor in the opening of agri-food businesses through the improvement of relationships with business partners (Cillo et al., 2019). These technologies have enabled new commercial partnerships to thrive. Similar to this, new clients in emerging and new markets may be reached and engaged. The technologies that can provide quick bi-directional connection and data gathering can then completely enable this interplay between external and internal information, which is the basis of OI (Bogers & Jensen, 2017). Thus, the number of studies on technology-driven OI in the agri-food sector is growing quickly (Bogers et al., 2020). Despite this, the majority of the research that is now available is either hypothetical or is based on examples of specific items that were produced using OI (Bogers et al., 2020; Bogers & Jensen, 2017).

Additionally, academics have mostly concentrated on the difficulties that agri-food enterprises encounter when attempting to launch OI efforts or integrate digital technology (Cillo et al., 2019). There are a few holes in this particular body of material. First, a deeper investigation of the phenomena at the organizational micro-level is required. Building on best practices, it is necessary to investigate the factors influencing the effectiveness of OI initiatives as well as the contribution of technology to bettering information flows. Following that, it is crucial to comprehend how crowdsourcing may encourage the creation of OI methods in the agri-food industry by utilizing already-existing knowledge-sharing systems. In particular, a more thorough investigation is required into the ways in which Sustainable OI (S-OI) may encourage the production of shared value across supply chain participants (Kamble et al., 2020).

To address today's issues, some authors present a theoretical construct of sustainability-oriented innovations (SOIs), which aims to bring about variations in philosophies, values, technologies, products, processes, and practices in order to generate social and environmental value in addition to economic value (Adams et al., 2016). Overall, SOIs are becoming more relevant to organizations that are seeking to transform their product and/or service portfolio (Bressan & Pedrini, 2020).

In the capacity of enterprises to become essential players within sustainable transitions, SOIs vary from typical innovation (Brown et al., 2019). Subsequently, businesses must adapt their procedures in order to achieve long-term success via innovation (Adams et al., 2016). As a result, SOIs are a superior alternative to typical innovation because they transform an organization's values to generate value for the environment, society, and economy by leveraging innovations in processes, products, organizations, and business models (Brown et al., 2019). Sustainable innovation has distinct features based on the context and sector, indicating a variety of goals for developing, emerging, and underdeveloped countries (Carrillo-Hermosilla et al., 2010). The agri-food business, in particular, has problems in terms of environmental, social, and economic sustainability and considers the full supply chain, from farm to fork, including end-users (Elkington, 1998). As a matter of fact, the global scope of the industry has an impact on these issues, as it involves a vast number of players with diverse capacities, competencies, goals, and resources operating throughout the agri-food value chain (Depken & Zeman, 2018).

1.3. The new sustainable consumer

Consumer interest in sustainable agri-food products has risen rapidly in recent years. This pattern suggests changes in consumer behavior, which have been affected significantly by greater social and environmental awareness. Sustainable agriculture, as defined by the United Nations Food and Agriculture Organization (FAO) and the United Nations Environment Programme (UNEP), is "a consumer-driven, holistic concept that refers to the integrated implementation of sustainable patterns of food consumption and production," highlighting that global consumers can become an influential driver of change toward more sustainable and equitable agri-food processes (FAO, 2018). Individual decisions are no longer just influenced by the maximization of the utility function as described by neoclassical theory, but instead incorporate social, ethical, and environmental aspects in what is more correctly referred to as a function of 'happiness'. As a result, two major patterns arise in this new 'consumer-individual" purchasing behavior: an increase in demand for safe goods related to food safety and an increase in interest in high-quality food products. Consequently, food consumption no longer just satisfies fundamental needs but also represents social, environmental, cultural, and ethical criteria for the long-term viability of production systems (Cecchini et al., 2018). Specifically, short food supply chains (SFSC) have gained popularity because they promise to improve food safety, social capital, and local economies, in addition to strengthening consumer-producer relationships (Edwards-Jones, 2010). In this respect, local food systems are also on the European Union's agri-political agenda (Dwarshuis-Van De Beek, L., 2011).

Because of these factors and due to rising consumer confidence in the globalized agri-food system, a new type of consumer is born in these years, the so-called "sustainable consumer". Most of them changed their preferences in favor of local and regional agricultural goods. Producers were encouraged to set up alternate solutions to local food supply schemes such as box schemes, community-supported agriculture, direct marketing, and farmer markets as a result of this (Aubry & Kebir, 2013). Therefore, consumer preferences move from "food from nowhere" (i.e., food from traditional food supply chains) to "food from here" (i.e., food from alternative food supply chains) (Schermer, 2015) and particularly within urban areas were encouraged by the re-creation

of types of relational closeness between consumers and producers (Jarosz, 2008). Consequently, metropolitan areas in Europe have a lot of promise for increasing local food supplies (Pradhan et al., 2014). Moreover, numerous cities in Anglo-American nations have implemented food policies to address food-related issues, hence food concerns have begun to be integrated into urban planning schemes. An increasing number of towns in Europe have expressed interest in incorporating food concerns into their political agendas. International statements such as the Milan Urban Food Policy Pact, which encourage local food systems in municipal governments, are one cause for the emergence of urban food policies (Dubbeling et al., 2017).

Despite preliminary studies on local food supply concentrated on simple representations of food flows, further sophisticated techniques, and conceptual tools have gained traction in recent years. Different food networks, foodshed analysis, and city-region food systems (CRFS) went beyond the description and analysis of local food flows to concentrate on the relations of local food resource flows with numerous actors in urban settlements, such as consumers, food activists, and political representatives (Blay-Palmer et al., 2013). CRFS examines the connections among cities and their environs, drawing on territorial techniques from rural research, the notion of foodsheds, urban food governance literature, and empirical studies of food policy efforts (Blay-Palmer et al., 2018). As a result, urban food system studies are heavily interested in evaluating cities' ability to localize their food supply throughout their surrounding areas (Cardoso et al., 2017).

Even though customers, citizens, users, and, more generally, civilized society play a critical role in the agri-food sustainability transition, research provides a fragmentary picture of their diverse responsibilities in this process of transformation (Verhees & Verbong, 2015a). The closeness of consumers/citizens and farmers has been the subject of several research and worldwide programs aimed at facilitating the sustainable transition of agri-food systems. This has been accompanied by a growing emphasis on transparency (R. V. George et al., 2019) traceability (Kittipanya-ngam & Tan, 2020) a variety of "green" and "sustainable" certifications as well as other projects. As a result, consumer marketing campaigns and sophisticated techniques are being focused in order to encourage "pro-environmental" customer behavior. This demand-driven, mostly liberal market strategy argues that well-informed customers would make the best decisions based on clear information, assisted by proper technologies and innovations

(Mehrabi et al., 2022), resulting in a market for sustainable agricultural goods as a result of marketing communications with consumers (Mishra & Singh, 2018).

1.3.1. How the agri-food supply chain communicates with the consumer

Communication with the consumer is typically accomplished through marketing in the agri-food supply chain. In most marketing research, a procedure known as "customer segmentation" is used with the goal of increasing sales (Wall & Chen, 2018). Marketing researchers have highlighted a conceptual model of environmentally sustainable customers patterns, providing numerous aspects for it, such as "consumer acceptance," "consumer perception," "consumer attitude," "in-purchasing behavior," and "willingness to pay," in order to select the optimal way to stimulate consumers' purchasing decisions. Customer segmentation targets each category based on its features and investigates driving reasons and ways for motivating more sustainable behavior and changing purchasing habits using various marketing techniques (Bollani et al., 2019). Consumers' perceptions of sustainability are used to define distinct clusters. The evaluation might be focused on their perceived value of the manufacturing process (given to the "fair trade" cluster), the product's local origin (assigned to the "local" cluster), or their willingness to pay for sustainable items (attributed to the "price-sensitive" cluster). As a result, these clusters give important information for businesses to employ in developing marketing strategies aimed at certain customers (Bollani et al., 2019). Furthermore, by examining trends and data derived from consumer segmentation, one may anticipate and assess what will or is likely to occur, predicting customers' needs or behaviors (Lezoche et al., 2020a). Additionally, anticipating customers' acceptance of new technology guarantees that new marketing methods be implemented successfully (Kamrath et al., 2019).

As consumers become more conscious and savvy, they are demanding food and ingredients that are pesticide-free, with minimal processing, easily available, affordable, and with the smallest environmental impact (Falguera et al., 2012). According to certain research, price and flavor indications no longer always overcome environmental and health factors when it comes to product selection by consumers (Blanco-Gutiérrez et al., 2020) and customers' "green" inclinations boost their readiness to spend a higher price for such items (He et al., 2019). As a matter of fact, customers feel better about buying items from companies that are ecologically and socially responsible (Toussaint et al., 2021). For this reason, corporate social responsibility (CSR) has evolved as a reaction to

customers' demands for intangible food characteristics (Sgroi et al., 2020). Despite this, the impact of CSR programs on customers is limited owing to a lack of understanding (Boccia & Sarnacchiaro, 2018). Additionally, several researchers have found that environmental concerns among buyers do not always influence agri-food purchase intentions (Robu et al., 2021). When it comes to purchasing, even customers who are devoted to specific sustainable and ethical values might put individual interests and requirements above sustainability goals, raising questions about consumers' long-term commitment to their consuming behaviors (Vermeir & Verbeke, 2006). Different approaches and projects have been established in reaction to the traditional view of the role of consumers in agri-food systems, suggesting more prominent participation for both individual and collective buyers in the agri-food value chain. For example, sustainable consumption has become a popular issue in marketing research (Robu et al., 2021). Several other initiatives followed, such as ethical consumption (Sciarelli et al., 2021), responsible customer behavior (Yoshikawa et al., 2014), conscious consumption (Spaargaren & Oosterveer, 2010), green purchasing and consumption (Guerreiro & Pacheco, 2021), as well as a green certification (Higgins et al., 2008). However, there is a gap in marketing, since merely a few have worked on the social aspects of sustainability (Cecchini et al., 2018). Most consumer behavior studies focus on individual customer behavior, including pro-environmental behavior in daily life, their knowledge of the environment, their attachment to green products, their pride and guilt, the individual perceived effectiveness, and their connection to nature (Ibáñez-Rueda et al., 2020). Because of dynamics and behavior processes, the functions of collective and individual users in responding to sustainable innovations vary, and large-scale social movements are created by collective consumers. Additionally, participating in communal acts of kindness gives people chances to connect, expand their networks, and find purpose and objectives in common, which is a compelling force for social movements (Verhees & Verbong, 2015). Therefore, it is necessary to move above only individual responsible purchasing in the market to systemic and significant societal change in order to address the present environmental, social, and economic concerns (Grasseni et al., 2013).

Chapter 2 “Digitalization of the Agri-Food sector”

2.1. Agriculture 4.0

Agriculture production has increased significantly during the past decades. As part of the so-called Biotechnological Revolution, technological advancements have not only sought to increase production but have also played a significant role in the opening up of new agricultural frontiers and significant changes in land usage (Sauer, 2018). The exploitation of ecological externalities that these advances assist to supply is shadowed by efficiency and development narratives, which claim that agricultural growth and productivity improvements primarily derive from technological advancements (Cáceres & Gras, 2020).

Food that is safe, secure, and sustainable must be provided by agri-food businesses. Traceability is required in many nations in order to improve consumer trust in the safety of their food supply and to promote food security for consumers. Hence, the adoption of new technologies is essential to ensure efficient and effective management of producers' responsibilities (Costa et al., 2013). Precisely for this reason, smart technologies are born. The word "smart" is an acronym for "Self-Monitoring Analysis and Reporting Technology," but it is often used to refer to any form of technology that is now accessible and enables users to connect to internet networks (Papadopoulou & Maniou, 2021).

The food industry's conventional strategy is going through a major shift. The first agricultural technology revolution achieved significant progress. For instance, contemporary agricultural techniques, such as irrigation, the use of fertilizers and pesticides, as well as the creation of new and more productive crop types, allowed the increase of yields. (World Bank, 2008). However, efficiency improvements are declining as yield increases have decreased. And the difficulties are bigger: by 2050, the globe must produce 70% more food while using less energy, fertilizer, and pesticides, all while reducing GHG levels and adapting to climate change (de Clercq et al., 2018). New technologies must be developed while optimizing existing ones. The upcoming agricultural revolution, known as Agriculture 4.0, needs to be technologically advanced and environmentally friendly (Beddington, 2010). This will need to include both the

supply and demand sides of the food-scarcity issue, reengineering the value chain and employing technology to meet genuine consumer demands rather than just innovating for the purpose of innovation. Because of technological improvements such as sensors, gadgets, machinery, and information technology, contemporary farms and agricultural enterprises will operate differently. Robots, Internet of Things, drones, and GPS technology, to name a few, will all be used in agriculture in the future. These innovations will make it possible for enterprises to operate more profitably, effectively, safely, and sustainably. (de Clercq et al., 2018).

How new technologies enable information integration and interoperability is a crucial aspect of Industry 4.0 (L. da Xu et al., 2018a). Both horizontally and vertically are involved in this digital integration. With regard to manufacturing and management within a company, horizontal integration deals with how information technology (IT) systems are connected across incoming suppliers, production, and shipment. Vertical integration is the process through which IT systems work together to provide a complete solution across manufacturers in order to meet client needs. Through adaptive, evolutionary, and self-organizing networks, integrated production processes inside producers complete global cooperation (Erol et al., 2016).

Agriculture 4.0 has the potential to change the agri-food industry into one that is knowledge-intensive (Gacar et al., 2017), where conventional production processes are replaced by more advanced ones (Andrade-Sanchez & Heun, 2010) and new business models are created to take advantage of the benefits that result from the adoption of new technologies (Latino et al., 2021b). The management of operations throughout the value chain must take into account a variety of data types (e.g., location, weather, behavior, phytosanitary status, consumption, energy usage, pricing, and economic information), employing sensors, machines, drones, and satellites to monitor animals, soil, water, plants, and people (Klerkx et al., 2019a). Despite innovation being frequently thought of as being technocentric, the emergence of Agriculture 4.0 thinking has caused people to focus more on environmental and social sustainability (Klerkx & Rose, 2020). For instance, when it comes to the hunger crisis in emerging nations, disparities in societal distribution and food availability are more often to blame than a shortage of food supply. Although boosting food productivity through technical advancements, particularly in poorer nations, does not end world hunger, it does raise productivity and improve food

security and wealth (Nally, 2016). Moreover, it has been emphasized that a sole emphasis on technological innovation runs the risk of strengthening unfair models and resulting in power loss for minority communities: advancements have allowed increasing possibilities for both developed and developing countries (Mann, 2018). If innovation is considered from more than just a technological standpoint, it may balance the agri-food industry, ensuring a fair transfer of power and the right to obtain nutritious food (Klerkx & Rose, 2020).

2.2. The link between Open Innovation and Industry 4.0

Today's definition of Industry 4.0 includes the digital transformation of the industrial and consumer sectors, from the introduction of smart production to digitizing all value delivery channels(Ghobakhloo, 2020). The existing research has a strong foundation for the connection between effective OI and digital technologies. Academics have noted a considerable interdependency between the use of digital technology and a firm's capacity to use outside information for innovation during the past 10 years (Dodgson et al., 2005). In fact, supply-chain-side technologies have shown to be successful in gathering data from suppliers, such as statistics on production processes and consumption of products. Therefore, these technologies may aid managers in obtaining technical details concerning the limitations of items and potential areas for future advancements (Ardito et al., 2020a). Additionally, consumer-side technologies, such as e-commerce and digital communication, have been seen to facilitate the interchange of information between businesses and customers (Rialti et al., 2018). With the assistance of these technologies, it is now able to learn more than ever before about the preferences of customers, the extra features they want in a product, and the extra services they might need. In this regard, firms embracing OI using digital technologies and idea crowdsourcing might considerably boost their competitiveness and shorten the time to market for their goods (Chesbrough & Bogers, 2014).

Such phenomena has recently begun to be seen in the agri-food sector as well. Indeed, historically, most agri-food industry innovations came from within (Alfranca et al., 2004). However, as technology spread, the majority of agri-tech companies became increasingly focused on OI (Cillo et al., 2019). Establishing connections with other companies involved

in the supply chain is one of the main goals of the deployment of digital technology (Ardito et al., 2020b). When used in the frame of reference of agri-food businesses, technology platforms like Industry 4.0 technologies are effective at streamlining the supply chain, keeping track of every step involved in introducing a product to market, and engaging stakeholders and customers who are engaged in what businesses have to offer (Trivelli et al., 2019). Digital tools including social networks, messaging apps, websites, etc. enable connection with both B2B and B2C customers (Rialti et al., 2018). Therefore, smart technologies are crucial for agri-food OI. These tools enable the gathering of information on consumer interests, readiness to pay a specific price, and regular e-commerce activity (Vlačić et al., 2019). In this context, agricultural and agri-food enterprises may employ digital technology to get helpful inputs from the public and then use these insights to create new goods. Sustainable agriculture producers may benefit from the use of digital technology to better reach new markets and respond to the information needs of customers (Rialti et al., 2022). (Faraoni et al., 2019)concentrated on the role that grocery merchants' e-commerce systems played in suggesting new products to developing customers. Therefore, OI projects including the design of new products and the enhancement of consumer-reach channels are made possible by 4.0 technology. Instead, because they are a key component in the invention of cooperative business strategies in agri-food firms, the implementation of smart technologies on the production and logistic sides showed significant potential in the implementation of new agri-food offerings (Fertő et al., 2016). The agri-food sector's adoption of digital technology may make it possible to combine supply chains. A firm may, for example, create systems for exchanging real-time data, which would then enable the transmission of inputs about innovative approaches that might be produced through the participation of new partners (Belaud et al., 2019). In addition, McKinsey Consulting noted that smart technologies make it feasible to track each stage of a product's development from conception through market launch (Alicke et al., 2017). As a result, by employing 4.0 technologies, agri-food companies may guarantee the provenance of each component in a product, for instance, by using blockchain protocols to keep an eye on suppliers (Bumblauskas et al., 2020).

The implementation of 4.0 technologies has the opportunity to greatly transform the current agri-food sector. Consequently, these technologies may provide digital continuity between suppliers and customers (Lowry et al., 2019). Customers could post a fresh

concept on social media or a website, for instance. The proposal might then be shared with suppliers by senior account managers from the agri-food industries. Finally, buyers are offered the collaboratively created product (Annosi et al., 2022a).

Agri-food companies may count on internal knowledge management methods and systems in order to implement effective OI plans and ensure the maximum benefits of such a strategic approach. Coherent systems must be studied in order to properly assess relevant data from customers and the supply chain. Knowledge management systems and practices are required to gather, exchange, organize, and evaluate the digital data produced by Industry 4.0 technology (Santoro et al., 2018). Thus, the knowledge that is not organized, distributed, or absent from a company's common culture, which includes knowledge dissemination, cannot be managed or utilized (del Giudice & della Peruta, 2016). Absorptive capabilities of agri-food firms are thus crucial in this situation to manage stakeholder relations and incorporate outside information into practice. The ability of a corporation to perceive the value of information and plan for its use in upcoming production processes is known as its absorptive capacity (Kiessling et al., 2009). To inform all different stakeholders of innovative ideas and facilitate discussion about a breakthrough product, internal knowledge gathering, analysis, and sharing procedures must interact (Griffith et al., 2012). When combined with knowledge management practices and systems, Industry 4.0 technologies might potentially fully realize their promise of supporting effective OI (Rialti et al., 2020).

2.3. The interconnection between smart technologies and sustainability

Several research takes into account the various features of Industry 4.0 technologies, including the contribution of cyber-physical systems to the development of smart factories (Chen, 2017) and the facilitation of smart supply chains (Peruzzini & Stjepandić, 2018). Three categories of Industry 4.0 technologies form the foundation of CPS:

- the Internet of Things, which is defined by the existence of numerous individually addressable cooperative things, including smartphones, sensors, and actuators;

- the Cloud and Fog Computing, which offer nearly limitless computing, storage, and communication capabilities as utilities, including on-demand and pay-per-use;
- the Big Data analytics that makes it possible to benefit from enormous volumes of data (Aceto et al., 2020a).

Due to their potential to connect the real world with the virtual one, these three categories of technologies are the ones that are most widely used, either separately or in combination, across many industries, including the agri-food industry (Lezoche et al., 2020b). The other categories of technologies that are capable of transferring to the agri-food sector the advantages that the Industry 4.0 paradigm has generated in the traditional manufacturing industries (Karadayi-Usta, 2020) include nanotechnology, artificial intelligence, robotics, machine learning, analytics, sustainable energy generation, data certification mechanisms, tagging technologies, and additive manufacturing (Bai & Sarkis, 2022). These technologies will enable the agri-food industry to grow up and realize more effective and higher-quality production (Zhang & Chen, 2020). For instance, by utilizing Industry 4.0 technologies, the agri-food sector can enhance its competitive efficiency through the use of big data analytics (Liu et al., 2021), the results of the supply chain, thanks to the implementation of information technologies (J. Sharma et al., 2020), or the degree of product customization, thanks to the IoT's ability to gather data on consumer habits and needs (Büchi et al., 2020). In this respect, during the course of around three years, the number of agri-food enterprises in the EU-27 using one or more of the 4.0 technologies climbed by more than 250 percent (Salerno, 2021).

In light of this data, utilizing the Industry 4.0 paradigm provides significant potential for the agri-food industry to advance (Luque et al., 2017). It must be stressed, nonetheless, that while adopting Industry 4.0 concepts, there are certain distinctions between the agri-food industry and other traditional manufacturing sectors to take into account. The agri-food sector is becoming more technologically intensive not only as a result of the fourth industrial revolution but also as a response to numerous first needs to sustain better process controls, leverage economies of scale, and guarantee food safety, variety, and quality. This is true even though conventional manufacturing industries continue to be technologically oriented over time, receiving first the innovation coming from Industry 4.0. Further contrast concerns trends in innovation typologies: in the traditional manufacturing business, product innovation outpaces process innovation, but the

opposite is true in the agri-food industry (Triguero et al., 2013). In order to lead markets and boost the quality or output of less scalable goods, agri-food corporations are more committed to process innovation. Industry 4.0 offers several inputs for the development of this kind of innovation (de Giovanni & Cariola, 2021). One of the most significant effects of such a technical progression was that thanks to these modern digital technologies, agri-food companies expanded the number of partnerships with their partners (Kafetzopoulos et al., 2020). In fact, digital technologies enable firms to gather more data from both internal and external sources. As a result, these new internal and external data allowed agri-food enterprises to better understand client interests and, as a result, concurrently design collaborative plans with their suppliers (Annosi et al., 2022b).

Smart technologies have a significant impact on essential business operations that go beyond just boosting effectiveness and efficiency. It establishes new foundations for societal and economic sustainability (Porter & Heppelmann, 2014a). Although the influence of smart technologies is undeniable, a number of reasons seem to be impeding their adoption and spread (van Knippenberg et al., 2015). In order to make decisions about crop, animal, or food production, smart agriculture employs information technology, the Internet of Things, and other digital tools and technologies (Annosi et al., 2019). This is accomplished with the aim of optimizing returns and protecting the environment. In fact, even though commercially accessible precision agricultural techniques and technology have existed since the 1990s (Daberkow & McBride, 2003), the spread of such breakthroughs has progressed at a relatively slow rate. There are two factors at play in this delay. First of all, neither the business models of the adopters nor the suppliers are designed to include such improvements (Long et al., 2017). This is due to the fact that, on the one hand, adopters must invest not only in money but also in developing new skills and competencies, and, on the other hand, providers must consider the complexity of technologies in view of adopters' technological readiness, which frequently necessitates complementarity between current procedures and new technologies (Adrian et al., 2005). Secondly, the adoption of these technological advancements may also be inhibited by other organizational issues, particularly on the adopters' part. These qualities include prior experience, understanding of and access to technology, education (Hudson & Hite, 2003), and a propensity regarding technology (Cochrane, 1993).

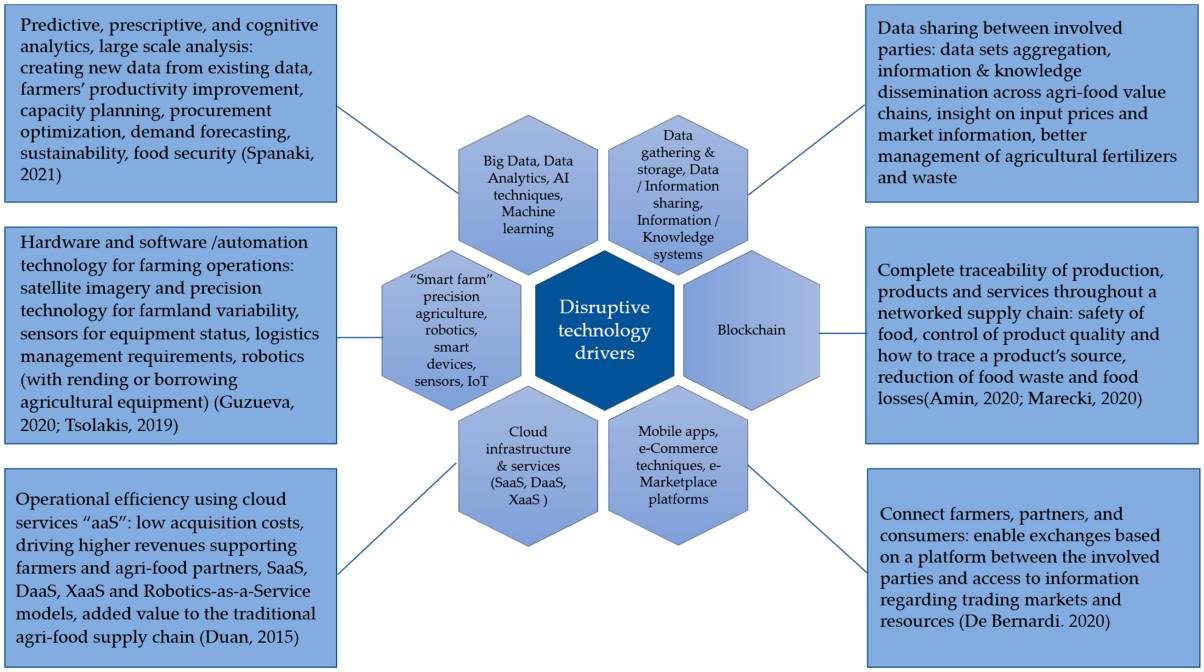

Figure 5 - Disruptive technology drivers and implications in the Agri-food industry towards digital transformation. Source: Vlachopoulou et al., 2021

2.3.1. Internet of Things

The Internet of Things (IoT) is a network of linked computers, individuals with individual identities, and the ability to communicate over a network without human contact. By interacting and sharing data via the internet, the Internet of Things seeks to link the real and digital worlds. Examples of IoT applications include interconnected industries, smart cities, smart homes, smart energy, connected cars, smart agriculture, connected buildings, health care, and logistics (Rehman et al., 2022). A number of agricultural modernization options may be offered using the promised Internet of Things collection of technologies. Scientific organizations, research organizations, and the agricultural industry are trying to provide agricultural business stakeholders an increasing number of IoT solutions, establishing the groundwork for a definite role when IoT becomes a dominant technology (Khan et al., 2021).

Examples of IoT applications in agriculture include farming systems, animal tracking, irrigation management, greenhouse environmental control, autonomous agricultural machinery, and drones. All of these contribute to agricultural automation. Moreover, it requires making a contribution to the long-term viability of the agricultural food industry. To meet these demands, agricultural yield forecasts, crop protection, and land assessment

are crucial for global food supply (Safdar et al., 2019). For instance, by utilizing smart sensors and mobile networks, farmers may more easily regulate fields and monitor agricultural settings in real time. Additionally, farmers may use IoT technology to gather crucial data and create yield maps that allow precision agriculture to provide affordable, high-quality crops (Sinha & Dhanalakshmi, 2022).

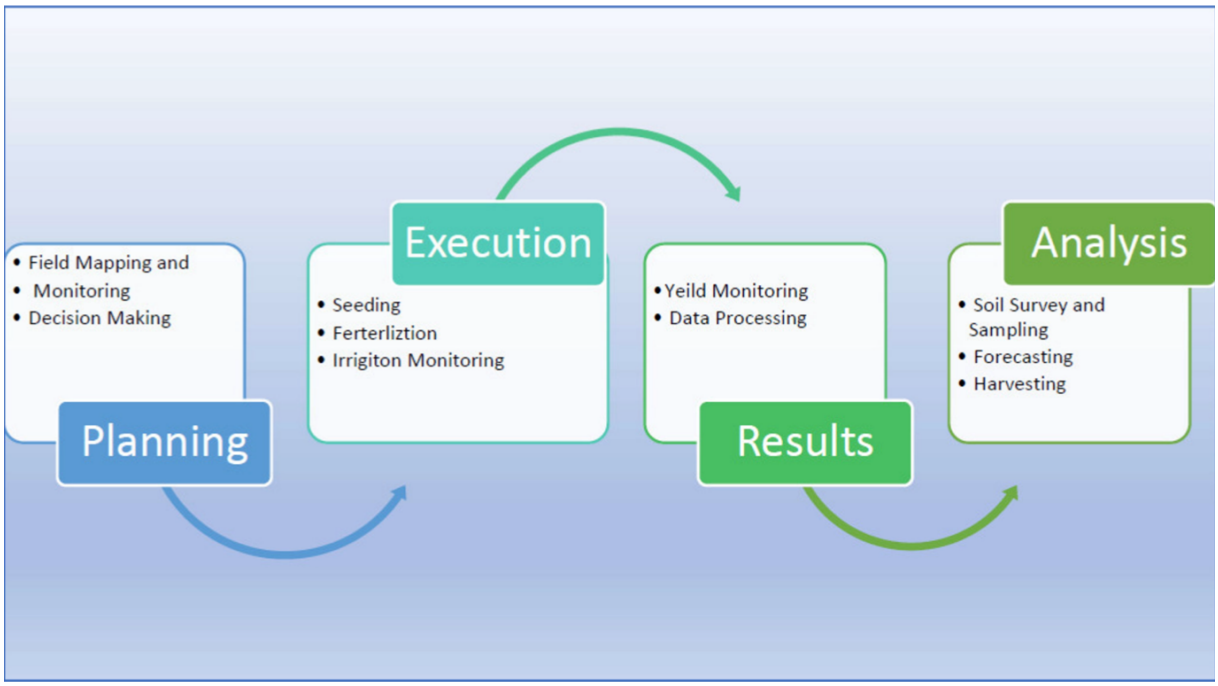

Figure 6 - Smart precision agriculture cycle. Source: Khan et al., 2021

Farmers now recognize the need of smart agriculture, and in the next few years it will be even more crucial to ensure optimal field expansion and crop productivity. Unfortunately, the increased demand cannot be satisfied using conventional agricultural practices. As a result of inadequate use of nutrients, water management, light, fertilizers, and pesticides, the land remains arid and devoid of fertility. The difficulties that various IoT automation and management systems may effectively solve include crop diseases, water scarcity, irrigation, and pesticide control (Kolivand et al., 2019). Because of this, modern agriculture uses sophisticated machinery and instruments from seeding to crop harvest, storage, and shipment. Due to its precise reporting capabilities and quick reporting using a variety of sensors, the operation is intelligent and economical. In addition to traditional agricultural machinery, autonomous drones, farm machinery, tractors, satellites, and robots are now available. Immediately after being installed, sensors may start gathering

data, which is then immediately accessible for online analysis. Sensor technology enables accurate data collection at each location, allowing crop and site-specific agriculture (Friha et al., 2021).

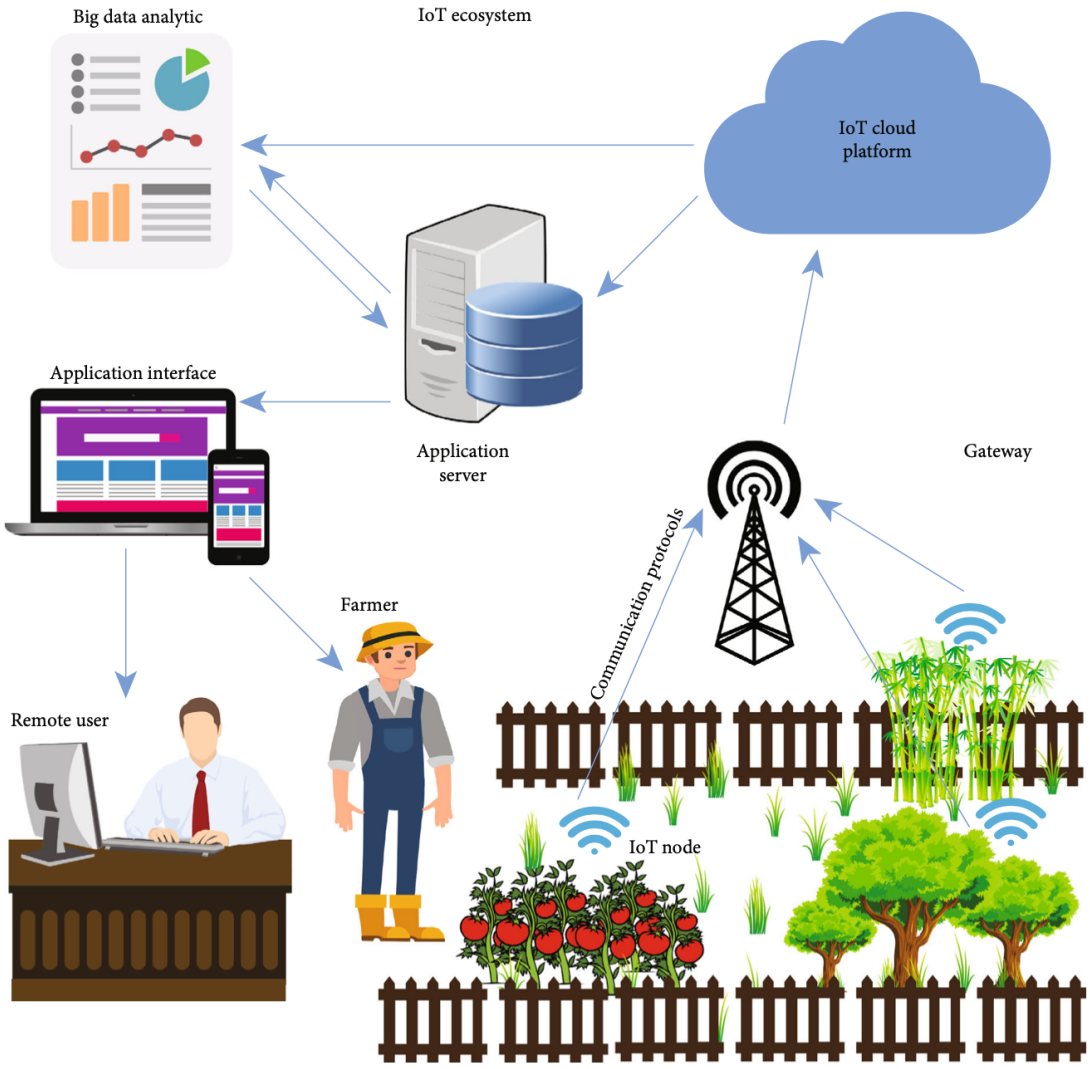

Figure 7: IoT ecosystem for agriculture. Source: Qureshi et al, 2022

2.3.2. Big Data Analysis

According to (Subudhi et al., 2019), big data is defined as a "conglomeration of the booming volume of heterogeneous data sets, which is so huge and intricate that processing it becomes difficult, using the existing database management tools." Big data is a relatively new and dynamic area of study that offers strategies for improving the

usability of data to derive important insights (Kellengere Shankarnarayan & Ramakrishna, 2020).

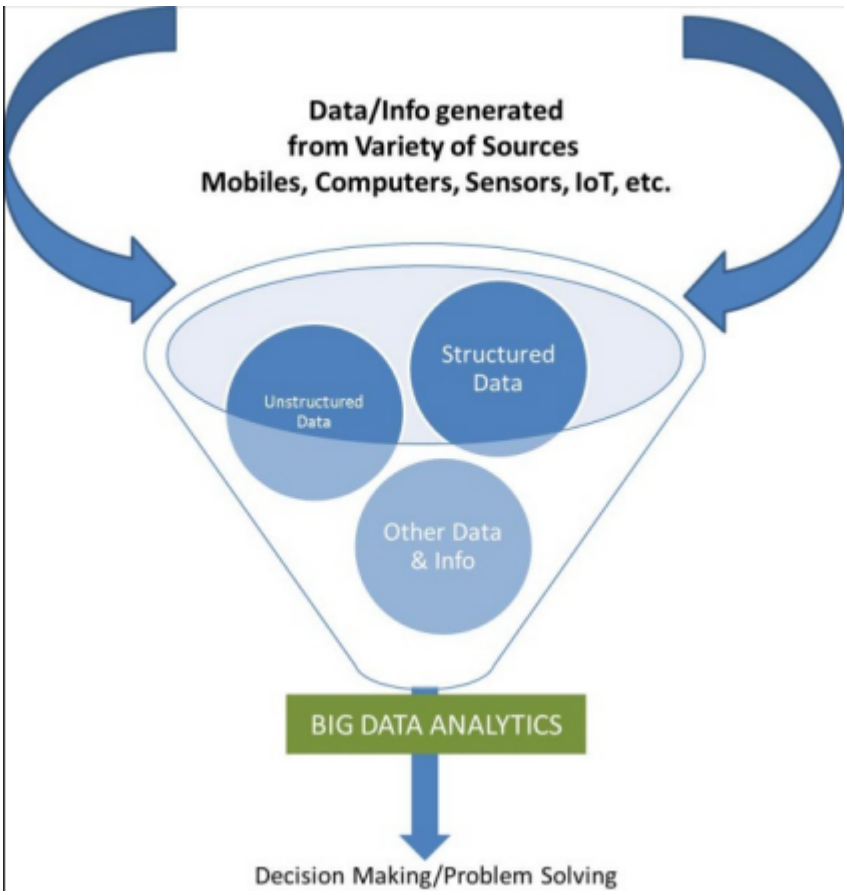

Figure 8 - Big Data Funnel & Decision Making. Source: Kumar, 2020

The processing and analysis of sizable parallel data sets derived from many sources, including online user interactions, commercial contacts, sensor devices, monitoring systems, and any other consumer monitoring methods, is the core of big data. Big data's crucial characteristic is its fine-grained structure (G. George et al., 2014), which is produced by powerful computers that watch a variety of digital streams and are then analyzed using "smart" algorithms (H. Davenport, 2014). Similar to how cloud computing ushered in a new age of technology change, big data refers to the continual generation of a vast amount of data from many data sources and in various data formats (H. Davenport, 2014). Existing research has also shown that big data has a number of characteristics, including volume, speed, value, and diversity (Aljunid & Manjaiah, 2019). These qualities have drawn a lot of attention from experts in a variety of fields. Beyond its technological applications, business researchers agree that big data is essential for the creation of agri-

food supply chains (AFSCs) that are more effective and efficient (Lioutas & Charatsari, 2020a). Big data may help with decision-making processes in several AFSC areas by providing different insights. Making proactive, data-driven decisions in AFSCs requires the use of big data, which offers real-time analytical insights. It provides the sharp insight and guidance (Lioutas et al., 2019) required for the successful administration of AFSCs to researchers, practitioners, and decision-makers in policy (R. Sharma et al., 2018). Big data can support AFSC partners in mitigating distortions in addition to assisting AFSC actors in making smart choices. This is done by lowering the economic waste associated with agricultural production (Lioutas et al., 2019), promoting the implications of agricultural policy (Coble et al., 2018), and enhancing the economic results of AFSC actors (Lioutas & Charatsari, 2020b). The advantages of big data also include giving food companies the capacity to effectively understand consumer tastes and desires, create goods based on real-time market information, and improve the general working environment and productivity levels of the company. According to the World Bank, the food and agricultural industry accounts for 10% of the global GDP, with the potential for expansion due to population expansion and changes in consumer behavior in the coming years (Coyle, 2016). Big data will inevitably play a role in this tendency given its wide range of uses, which are often connected to the agri-food sector. However, due to concerns with data protection, privacy, security, and ethics in AFSCs, the advantages of big data for AFSCs cannot be realized easily (Klerkx et al., 2019b). The technological and governance issues that may surface during the various phases of the AFSC provide a barrier to the deployment of big data for smart farming (Wolfert et al., 2017).

2.3.3. Cloud computing

With the help of the internet, users may access shared amounts of reconfigurable system resources thanks to the concept of cloud computing. Coherence and economies of scale are made possible by such resource sharing, which has the same effect as a public utility and may be promptly distributed by service providers to customers with minimum management effort (The new age: Cloud computing in agriculture, 2020). This implies that consumers may access the cloud network program over the internet and is not required to use their computer's hard disk.

There are three service models that are often used in cloud computing. Software as a Service (SaaS): this term refers to a website that the end user will interact with online.

Customer relationship management (CRM) and the data center that Amazon Web Services has exhibited are two instances of this concept. Platform as a Service (PaaS): the Google App Store is the greatest illustration of PaaS. It is mostly intended for developer activities who want to immediately deploy their apps on the cloud server and don't care about connecting to the server infrastructure. Finally, IaaS (Architecture as a Service) enables developers to engage in the maximum degree of direct engagement with server infrastructure. Additionally, it enables them to deploy and manage their own applications in distant environments. Nowadays, the SaaS model is the most used in the current sector (Almarabeh & Majdalawi, 2018).

This stacking format offers services to several user groups, including end users, application developers, etc. Likewise, cloud computing may be private, public or hybrid depending on how it is deployed. This makes it more affordable by allowing people or companies to personalize the service to suit their requirements and pay just for the type and duration of the service. Users benefit from the ease of the services since they are accessible via the internet and devices with internet access (Fu, 2022).

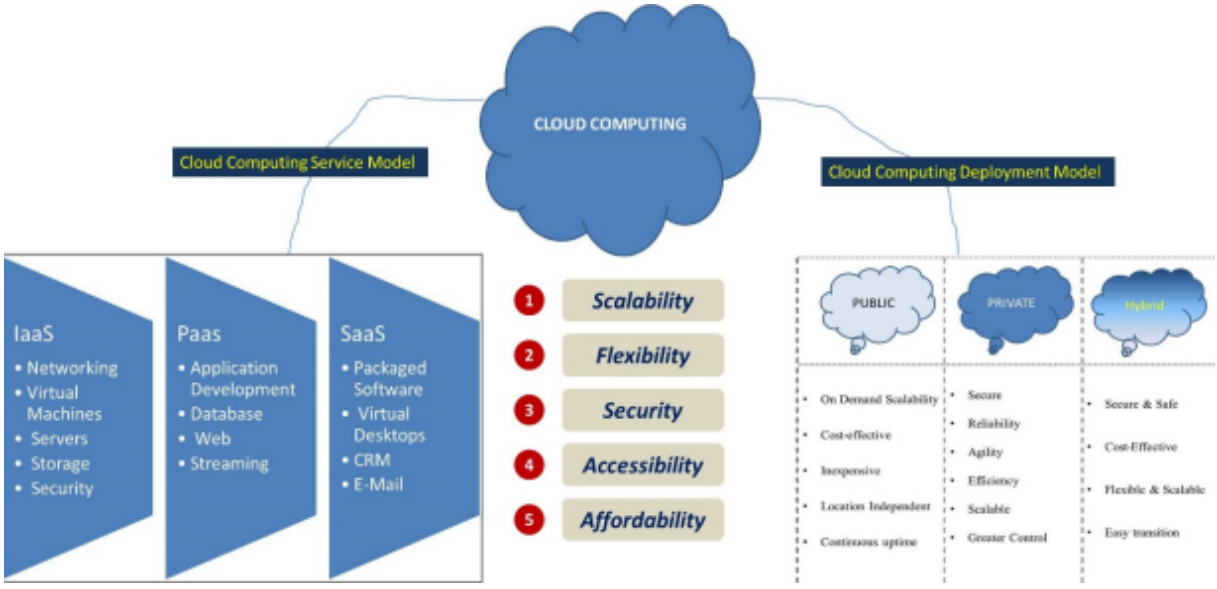

Figure 9: Models of cloud computing based on services and deployment. Source: Kumar, 2020

As implied by the name, a public cloud offers services across a network. Since it is location independent, no one or entity has control over the infrastructure. More security is provided by private clouds, which are designed for use by a single company with exclusive access. This is crucial for companies like government agencies that need to handle data

security. Hybrid clouds combine the benefits of both public and private clouds, allowing users to access some apps that require high security through private clouds and others that can be controlled with less protection through public clouds. A hybrid cloud provides a great deal of flexibility and privacy (S. Kumar, 2020).

People may benefit from real-time calculation, data access, and storage thanks to cloud computing without having to be aware of or concerned about the precise location and set up of the system delivering the services. It can gather data on all crops that have recently been planted, which can assist farmers in deciding what to plant next. Decision-making regarding crops also heavily relies on knowledge of the land. In addition to the soil profile, it may also show the soil's historical history, which aids in forecasting its future tendency. It is possible to regularly and in different locations check the growth of different harvests. Rural residents are not able to sale their own products at the market directly. There are a lot of intermediaries who arise between the retail and production sides, which eventually results to farmers being exploited. Farmers may sell their goods straight to consumers or shops by using the cloud-based agriculture management information system (The new age: Cloud computing in agriculture, 2020).

Companies from all industrial sectors are increasingly depending on cloud-based solutions offered by specialist companies to boost their competitiveness (by keeping an eye on their supply chain) and enhance the effectiveness of their internal activities (L. da Xu et al., 2018b). By utilizing cloud-based services, integrated production systems may be created without the burden of creating alternative architectures or the requirement to train the whole workforce (Cotet et al., 2020). Data collection and Big Data Analytics may be carried out with just a internet connection and a basic PC thanks to cloud-based technologies and the usage of virtual machines (Rialti et al., 2018).

2.4. Smart Technologies interconnection to reach innovation and sustainability

The use of information and communication technology (ICT) in agriculture is growing in importance as a means of enhancing agricultural output and quality. This is due to increased internet penetration, decreasing data costs, and increased smartphone

accessibility among rural migrants. IoT, cloud computing, and big data analytics are examples of ICT solutions that show enormous potential for changing the organic, intelligent agricultural mindscape and landscape and delivering profitability and sustainability. By lowering their risk, increasing their productivity, and lowering operational costs, the anticipated technological farming has the capabilities to positively impact the whole organic agricultural value chain stakeholders, bringing about changes in farming methods, seed and other agricultural practices, better crop protection, enhanced practices after harvesting, appropriate management of warehousing and logistics, and promoting environmental sustenance. Additionally, making data more easily accessible, incorporating digital education into policy frameworks, including information as a key component of government projects for agriculture, and supplying the very important digital architecture in rural environments would open the path for the digital revolution in organic farming and its related value chain. The younger generation would become more interested in farming as a result, which would aid in the creation of rural jobs through entrepreneurs (S. Kumar, 2020).

Figure 10: Advantages of using IoT, Cloud Computing and Big Data Analytics in Organic Agriculture. Source: Kumar, 2020

Transparency, traceability, and authenticity in organic agriculture should be incorporated as the world moves toward safe food and nutrition; this may be done by employing the ICT technologies that have previously been mentioned. The effort just won't be enough till and unless a micro perspective or local viewpoint is considered for reaching increased production and sustainability targets. The time has come to use technology intercropping with cloud computing, big data analytics, and IoT under organic agricultural methods for the benefit of small and medium farmers as well as other stakeholders in the value chain. To turn the entire plan into a workable concept, will require a powerful political program, the ability to update policies, and the right digital infrastructure (S. Kumar, 2020).

Chapter 3 “Digital and sustainability aspects of the Agri-Food marketing”

3.1. Digital Marketing

The term digital marketing refers to the use of digital channels to market products and services in order to reach consumers. This type of marketing involves the use of websites, mobile devices, social media, search engines, and other similar channels.
Digital marketing involves some of the same principles as traditional marketing and is often considered a new way for companies to approach consumers and understand their behavior. Companies often combine traditional and digital marketing techniques in their strategies.

3.1.1 Sustainable marketing

Creating and promoting goods and services that satisfy customers' needs in terms of quality, effectiveness, cost, and convenience without having a negative impact on the environment, society, or the economy is known as sustainable marketing. Smart technologies are used to advertise the product and support sustainability initiatives and habits in businesses (Nosratabadi et al., 2019).
One of the drivers in the current period that helps to create value for the consumer are innovative technologies (Seretny & Gaur, 2020). One of the most important components in enhancing the marketing environment is data, and technology has produced a variety of methods for creating data (Mohanraj & Karthikeyan, 2016). By expressing and engaging with human feelings, several social media and mobile apps today serve as "social sensors" (Andrienko et al., 2017). A low-cost tool for planning marketing initiatives is the information generated about people's attitudes and wishes. Big data management in marketing is related to each of these elements, as well as the demand for real-time insights. The Internet of Things is one of the most significant sources of big data, making it a potential asset for attaining marketing objectives.

The environmental, social, and economic issues that the world is currently experiencing rank among the most significant challenges that organizations and businesses need to

make a special effort to address (Saura et al., 2020). The mentioned three elements contribute to sustainability (Suchanek & Szmelter-Jarosz, 2019). Customers need sustainable marketing if they desire sustainable enterprises (and products or services). This idea, which is a component of sustainable development, seeks to boost production in order to avoid harming ecosystems or depleting natural resources (Marzouk, 2019). Because of this, sustainable marketing is a subset of the larger field of sustainability. This idea includes standard economic marketing, social marketing, and environmental, or green, marketing (Andronie et al., 2019).

The figure illustrates how sustainable marketing is built on three pillars in addition to the conventional classification into three aspects: economic, social, and environmental. Firstly, it lessens waste and risks by, for instance, employing courier packaging and advertising techniques that can be reused. Secondly, through collaborating with clients and other stakeholders, sustainable marketing motivates clients. Businesses may rely on loyal clients to advertise on social media platforms and spread information. Thirdly, it should assist with the long-term strategy.

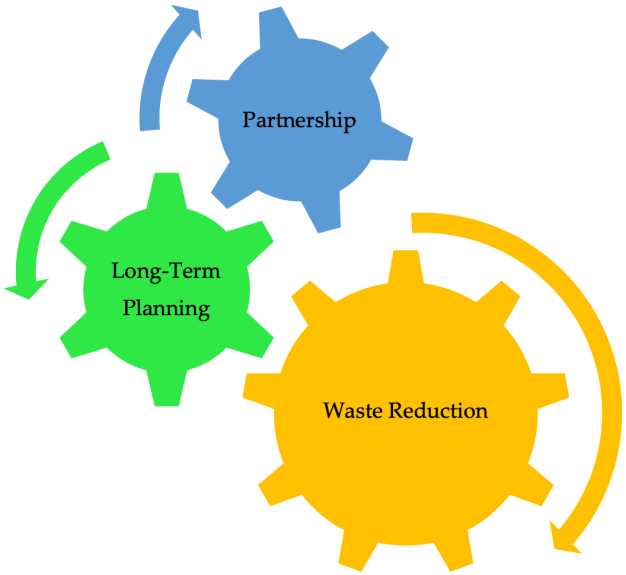

Figure 11 - Basic principles of sustainable marketing. Source: Nozari et al., 2021

3.1.2. Digital marketing of agri-food firms

The traditional definition of marketing is the collection of actions that an agri-food firm engages in, from the acceptance of a product or service to the consumer's usage (Deepak & Jeyakumar, 2019). Nonetheless, it is challenging to accurately describe the notion of marketing. This is presumably because marketing theories and practices change and evolve throughout all eras and competitive environments. Accordingly, the challenge of coming up with a single definition is strongly related to the development of the market's reference framework, the agri-food firm, the technologies that the discipline has found itself working in through time, and adapting (Chandra, 2019).

The classical and modern interpretations differ significantly in that the former is solely focused on the paradigm of innovation market-pull, which only allows for the introduction of goods into the market of which buyers have explicitly stated a desire (MacFie, 2007) whereas the latter involves the innovative technology-push or the introduction of goods and services that surprise consumers either because they are unable to communicate their needs or because they do not believe that they can be satisfied (Galati et al., 2016). Due to the progressively widespread adoption of digital technologies and the fact that their use is gradually becoming more common to a growing population, a strategy that, despite apparent risks associated with a lack of consumer acceptance, characterizes the present phenomena of breaking with the past that are arising regularly and with significant results for business profitability and for values shared to final users. Particularly, since the World Wide Web (WWW) was created on the Internet at the beginning of 1990s, more businesses have been utilizing the WWW as a innovative marketing channel (Jalilvand et al., 2011). The Internet's continual and growing presence in the global economic landscape forces the extinction of old forms of marketing; as a result, the identical marketing strategies used on the Web will be different from those used on conventional media (Sparkes & Thomas, 2001). Along with e-mails and social media, the Internet is only one of the digital media that are readily accessible nowadays that anyone may use to communicate anytime, anywhere. This is made possible by the wide variety of gadgets. Physical models, which have historically been closer to customers, are progressively integrating with the Internet and other digital mechanisms in general.

There had been a long-held belief that all conventional business practices will be replaced and cannibalized by the internet. The Internet frequently complements existing business practices and techniques of competition rather than destroying them. Physical activity still has to be done, but digital activities tend to emphasize how important it is to do so. The internet also opens up new possibilities for more effectively satisfying customer needs (Constantinides & Fountain, 2008). In addition to being technological, the transition has also been cultural. People realized the need for alternative means of self-expression and interpersonal communication throughout the closing decades of the previous century. This need was recognized by digital systems, which then supplied the technology to address it (C. M. Bruhn, 2008).

The sharing of information is increasingly important in the market and is one of the most fundamental shifts, even more so than the trade of products (e.g., Caporale & Monteleone, 2004). Nearly 2 billion people use social media and messaging services, while there are roughly 3.77 billion of people that use Internet worldwide. These users can access the internet at any time and from any location thanks to electronic devices such as computers, smartphones, or tablets. This allows them to engage and trade goods, services, and ideas in a way that is quicker, less expensive, and more thoughtful than it was in the past (Calantone & Vickery, 2010).

Since consumers have such easy accessibility to a variety of knowledge at low cost, they are becoming ever less the smaller party in the trade. They become more conscious of the relative worth of the various offerings as a result (e.g., Gunes & Tekin, 2006). They predict being able to select from a variety of more individualized goods and services, compare costs from various suppliers, and interact with customers from across the world. Consumers may now access a greater variety of data with less effort, expense, and cheaper transaction costs. Consumers' conventionally constrained logic progressively makes way for increased awareness. By giving the public more precise, real-time information data on pricing, product availability, variations, delivery methods, and timings, digital platforms have altered how consumers make purchases (e.g., C. M. Bruhn, 2007). Over the past few decades, developments and advances in the environment in which agri-food enterprises work have unavoidably affected how they conduct business (Caiazza & Volpe, 2012). A few examples of different factors that have altered how people live and work in the agri-food business include globalization, innovation,

internationalization, competition, technology, changing customer preferences, and demands from other supply chain participant.

Additionally, the use of the Internet has rapidly increased for businesses functioning in this environment. Millions of individuals use the Internet to purchase food, evaluate food options, and more. One of the most frequently posted topics on social networks is food. Digital marketing for the agri-food industry is thus a fantastic chance for businesses to develop. The food business is leading the way in interactive marketing innovation. Businesses in this sector collaborate with advertising agencies and high-tech experts to create campaigns that encourage users of social media, mobile devices, and virtual worlds to connect with them. Furthermore, there are indications that large brands have dramatically boosted their online advertising budget, with an increase of twice or even three times as much (Montgomery et al., 2011).

In this new environment, the agri-food firm must view itself as primarily an information supplier and recognize that it is dealing with a different kind of consumer who now actively participates in the marketing process. Studies emphasize how simple it is to quantify the impact of any product's attributes on a consumer's impression of the product itself, which in turn influences his choice to consume as well as his willingness to pay a premium price (Booth, 2014). As a result, the website's information, offerings, and services are what draw customers to the agri-food firm. However, the choice of which websites to visit is made by the online users based on the information that interests them as well as how and when they would utilize it (e.g., N. V. Olsen et al., 2010). Because of this, the features of the medium force a complete change in the marketing strategy, which is now no longer selective or push, but attractive or pull. Online marketing requires primarily putting the customer in the middle of attention before, during, and after the purchasing process; creating a dialogue that is as genuine and loyal as possible, in which the selling is not the main goal, but a logical outgrowth of the relationships created. The transition from a sales-driven business model to a customer-focused one necessitates a fundamental shift in company philosophy (Sheth et al., 2000).

The procedure for developing new food products must be altered as a result of these changes. Agri-food businesses must create new consumer-valued goods in order to thrive in an environment of increasing competition (Jacobsen et al., 2014). The demands of the client are grasped by the agri-food industry through market study at the beginning of the

new product development process. The knowledge it yields inspires the development and manufacture of goods and services that meet the specified demands. The agri-food business establishes a price, advertises a good or service by educating consumers about its qualities, and distributes it to consumers. However, from a contemporary viewpoint, marketing expands its scope of influence to other topics and beyond the boundaries of the agri-food industry and the marketplace (Saguy & Sirotinskaya, 2014).

3.2. Tools in digital marketing

The increasing significance of digital, social media, and marketing platforms, along with smart technologies and additional technical breakthroughs, have all revolutionized marketing. Thanks to these technologies, which increase brand awareness, increase sales, and reduce costs, global enterprises have several possibilities. As a result, marketers may accurately target micro-consumer groups inside the area or country and provide localized solutions, engagements, and experiences thanks to the development of smart technologies including connected technologies, artificial intelligence, sensors, and big data (Liu et al., 2020). These developments have also altered how customers act in different contexts. For instance, how people interact and satisfy their material, emotional, and economic needs has been greatly impacted by the fast development and use of digital and smart technology (Morgan-Thomas et al., 2020). With this approach, the 20-year technological transformation of marketing has been presented through new technologically enabled prospective consumer and corporate behaviors, interactions, and market experiences. Therefore, more articles have been published in national and worldwide marketing periodicals during the course of the same time period. The importance of these business models will increase as smart technology develops (Duan et al., 2019). Companies' approaches to market change as a result of the adoption of new digital channels. This will have an impact on how these businesses produce value for their clients and how they acquire this value for themselves and their stakeholders (Büyüközkan & Göçer, 2018). Accordingly, these new types of businesses are referred to as digital business models (Verhoef & Bijmolt, 2019).

The environment for businesses is quickly changing as a result of digital technology (Kannan & Li, 2017). Information asymmetries between businesses and their consumers

have significantly decreased because to these technologies. Determining how consumer behavior changes as a result of different technologies in online and mobile contexts is the first step in the investigation of interconnections between environmental factors and digital technologies (Pantano et al., 2018). This has an impact on how data is gathered on links between pricing and quality, information seeking, expectations, and the results for businesses (Diaz et al., 2021). The primary goal of marketing research is to gather and analyze data from digital media in order to understand the reasons, actions, and outcomes particular to the environment that affect a company's marketing choices (Verhoef & Bijmolt, 2019). To understand how the market perceives a firm, some examples include examining consumers' online search behavior, comparing website and mobile parameters, learning from feedback, social media interactions, and social tagging (Florenthal, 2019).

These activities are made possible by smart technologies, which are characteristics added to gadgets that enable intelligence. These characteristics allow the devices to have memory, be accessible, associated, configurable, communicative, and reactive. Physically based processes or equipment that are enhanced by digital technologies' smart features are referred to as smart technologies (Yoo, 2010). Smart technologies are technologies that support a new form of value creation and collaboration that leads to competitiveness, entrepreneurship, and innovation (Gretzel et al., 2015). The innovations lie less in the specific technology, goods, or services themselves than in how they are linked together, coordinated, and integrated into systems that function as a whole (Höjer & Wangel, 2015). It has become evident that technology developments at the macro level, including artificial intelligence, big data, cloud computing, and the IoT, are enabling and having an influence on smart technologies in several ways, even though these advancements are developing in a continual cycle of growth and innovation. Smart technologies have taken center stage as a result of the increasing adoption of technology across all sectors of the economy. Smart technologies in particular have opened up new business prospects across a number of industries (Chang & Chen, 2021).

3.2.1. Big data

The cost of acquiring customers is rising in a moment characterized by intense competition. Additionally, it has never been harder to comprehend and manage the client relationship lifecycle and retention strategies (Gupta et al., 2006). Businesses have used

current technology to maintain their competitive position in the market as supply chains become more complicated and intertwined, the need to build solid customer connections and the pursuit of increased production process efficiency (Moradlou & Backhouse, 2014). In this sense, a rising body of research has described big data's substantial effects and the ways in which they are changing the commercial environment (Akter & Wamba, 2016). Similar to this, big data's importance in assisting decision-making and enhancing a variety of organizational tasks, from marketing to the supply chain, is becoming more widely acknowledged (Waller & Fawcett, 2013). The capacity to derive important insights from the accumulation of novel data kinds and quantities in creative ways that would not have been technically and financially possible with traditional computer models is one of the high expectations provided by big data. Businesses profit from text analytics' result, which comes in the form of accurate, fine-grained knowledge that makes it possible to create new goods and services (Davenport, 2012). Big data is used to improve communication procedures including idea sharing across supply chain partners, research into market-based issues, and estimation of market scale and rivals (Tan & Zhan, 2017). For instance, merchants may employ cutting-edge big data analytical techniques to gather enormous amounts of sales-related data and simulate their demand and production projections for the next periods, thus boosting the profitability of their manufacturing and retail businesses (Shen et al., 2019). Because of this, organizations can establish educated decisions, enhance supply chain efficiency, and increase brand loyalty thanks to big data's predictive powers.

Big data is an essential resource for creating information and assisting decision making in situations where management and customer-related choices are frequently knowledge-based (Mawed & Al-Hajj, 2017; Tan & Zhan, 2017). Big data is not a huge archive for enormous data collections. The capacity to acquire, analyze, and use information in real-time to provide practical intelligence and commercial advantages is what is more important (Mawed & Al-Hajj, 2017). Big data methods are used by businesses to follow the flow of information, analyze enormous amounts of data, quickly create replies based on particular, unique, and personalized knowledge, and communicate data and information with clients and other stakeholders (Z. Xu et al., 2016).

3.2.2. Internet of Things

The use of the data from IoT-enabled devices can be fundamental in marketing, especially to decide which action to take and which marketing campaign to run (Hofacker et al., 2016).

IoT will make it possible for users to get brand-new services like alerts and notifications of product modifications (J. Wu et al., 2017). In fact, smart linked devices provide new client interactions for businesses, necessitating new marketing techniques and skill sets (Porter & Heppelmann, 2014b). Exploiting consumer data for innovative product development is becoming crucial for companies to achieve and keep a competitive edge in the market, achieve high levels of profitability, and remain competitive over the long term (Feng et al., 2012). In particular, companies focused on consumer goods have increased their use of their user communities' creative potential to energize their pipelines for developing new products (Nishikawa et al., 2013).

Another strategy to increase customer satisfaction and interaction is the intervention design, which permits the user to intervene in some part of the smart product actions (Schweitzer & den Hende, 2016). It is important to underline that Consumer adoption of new IoT goods is based on perceived trust, utility, and usability (Gao & Bai, 2014). Consumer resistance to smart devices is influenced by perceptions of novelty, invasiveness, cost, and usefulness (Mani & Chouk, 2017). Consumers' decisions to buy new items are influenced by a wide range of issues, including environmental considerations. Marketing encourages sustainable consumption by promoting environmentally friendly innovative product design (P. Kumar & Ghodeswar, 2015).

3.2.3. From Internet of Things to Internet of Everything

Internet of Things is frequently seen as a component of Industry 4.0 as well as its successor (Rejeb et al., 2020). This concept is based on the idea that items may communicate with each other by sending and receiving messages via the Internet. Its growth led to the emergence of "smart" items including machinery, homes, factories, etc. Naturally, this communication generates a lot of data that may be used to study how individuals behave (Tariq et al., 2020). One strategy for marketing efforts to maximize the company's decision and strengthen its competitive advantage is to utilize those databases. The IoT has evolved since its inception in 2010, and today's methods of linking items are

considerably more sophisticated than they were at the beginning of the Industry 4.0 period.

A more sophisticated version of IoT is the so called Internet of Everything (IoE). Its premise involves relationships between individuals, groups, systems, data, and things (Farias da Costa et al., 2021). IoE is described as "a network of networks that reunites people, processes, data, and objects in network connections more significant and valuable than ever" by CISCO in 2012 (Ilyas, 2019). IoE creates a sophisticated, cognitive network of things as a result. IoE encourages the development of new capabilities for both society and enterprises (G. Xu et al., 2019). The IoE paradigm goes beyond the concept of IoT, specifically:

- The Industrial Internet (II), interested in industry-relevant data;
- The Internet of People (IoP), particularly interpersonal relationships and social networks;
- Internet of Services (IoS) (Daú et al., 2019).

Additionally, IoE combines nanosensors in multiple objects via nano-networks. As a result, it presents a novel idea known as the Internet of Nano-things, which appeared unthinkable in the past. Additionally, IoE enables links between people and machines that are more beneficial than machine-to-machine communications (Srinivasan et al., 2019). As a result, IoE goes beyond the connections between items and incorporates them to create a particular linked civilization. Therefore, under the IoE notion, smart services and things define "everything" (Auger et al., 2018).

IoE needs sophisticated capabilities and information-sharing abilities. IoE technologies are able to harvest and evaluate real-time data from a variety of items (typically big data analysis tools). Robotic systems and human operators can become autonomous service agents in diversified IoE contexts. IoE application design and development have thus grown quite complicated. Artificial intelligence (AI) may be included in smart devices to boost the impact, allowing people and objects to interact in multi-user environments with suitable social contexts (Raj & Prakash, 2018).

3.3. Search Engine Marketing

The technique of marketing a company through sponsored adverts that show up on search engine results pages (SERPs) is known as search engine marketing (SEM). Advertisers place bids on keywords that customers of search engines would use when seeking for certain goods or services, giving them the chance for their adverts to show up alongside search results for those keywords. These advertisements, sometimes referred to pay-per-click advertisements, come in a number of forms. Some are brief, text-based adverts, while others, like product listing ads, are more visual, product-based promotions that quickly let customers see key details, such as pricing and ratings. The biggest advantage of search engine marketing is that it gives businesses the chance to display their adverts in front of motivated consumers who are prepared to buy at the exact moment those consumers are prepared to do so. It has been established that search engine marketing, which enables businesses to target customers by posting advertising on search engines, is a successful audience development technique. In contrast to conventional web advertising, advertisers only get paid when customers click on an advertisement. SEM may produce consistent traffic levels and a fantastic return on investment (ROI) when used effectively. The intensity of competition is pushing bid prices up as SEM usage increases (Panchal et al., 2021).

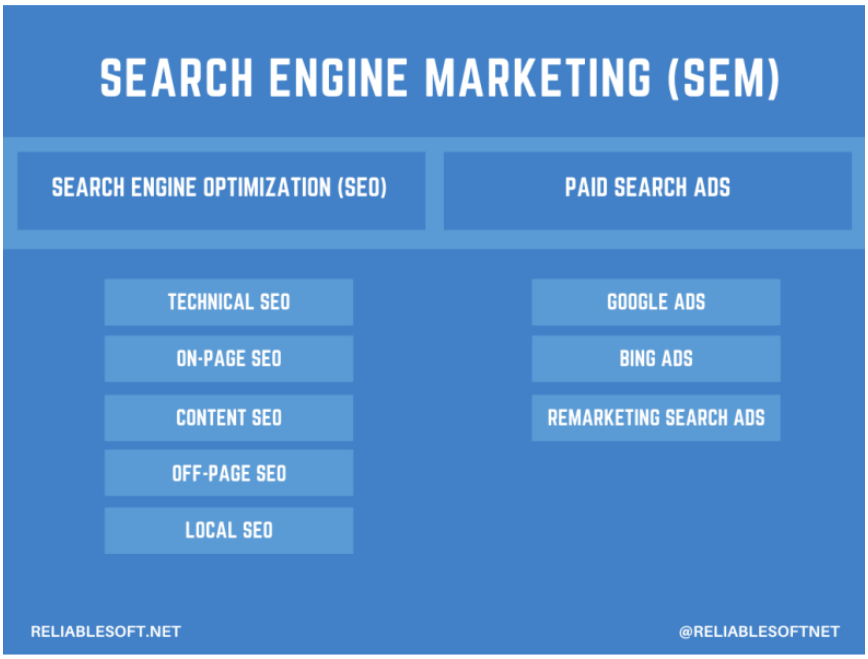

Figure 12 – SEO and SEM, Source: Panchal et al., 2021

By employing the functioning mechanism or algorithm of the search engine, search engine optimization is a set of procedures carried out methodically with the goal of increasing the quantity and quality of traffic through search engine visits leading to certain sites. Search engine optimization, often shortened to “SEO” is a strategy used to optimize a website so that it appears higher in search engine results when users input certain keywords to hunt for certain content. The goal is to make the web development readily rankable on a web search page with consistently updated information. By attracting more investors' attention, marketing efforts can reduce SEO price discounts.

The first rankings in organic search results should be attained using search engine optimization tactics. Although the fundamental of SEO remains the same, some optimization tactics do not alter over time. But since the Internet and web design change quickly, new optimization strategies succeed and fail. It is crucial to stress that none of the strategies can ensure a high ranking since search engines employ complex algorithms to assess the value of web pages and determine where they appear in search results. SEO is the process of making scholarly material more visible to academic search engines in general and Google Scholar in particular. Additionally, an enterprise can use a SEO mechanism to improve the ranking of its website in search engine results. SEO is more expensive than sponsored advertisements, does not always provide results that are profitable, and does not always result in high search engine ranks. It suggests that businesses would spend money on SEO. Its ranks were more constant if it were less pricey. Hence, techniques for SEO have emerged as a key method for raising website rankings (Iskandar & Komara, 2018).

The impact that keywords play in website optimization is significant. A properly optimized website must, at the very least, analyze the right keywords. There are three categories of keywords with varying search volumes:

1. Head: the head keywords come first; they are single-word phrases. They are known as head keywords since they stand for the graph's top elements.
2. Body: the body keywords, which are sentences of two to three words, come in second. Due to their structure, these are less competitive and may receive fewer searches overall.

3. Long Tail: the third category is made up of long-tail keywords, which are more detailed phrases. Due of their lower competition and less specificity, they have fewer searches.

It is possible to use one of the many keyword analysis tools available to find the right keywords to attract more visitors to your website. It is possible to access the keywords based on two criteria to minimize the keyword list:

1. Use search volume data: how many Google searches the keywords receive each month will allow to determine which of those themes is the most popular and which keywords are more common.
2. Evaluate the business value and commercial intent of certain terms (Panchal et al., 2021).

Hence, it is fundamental for a company that wants to be competitive to include such tool in its digital marketing strategy. Due to the forte competition of this digital era, a company that has a website should have an organized SEM plan because, nowadays, it is technically impossible to reach the top rank of search engines without it. The only method to reach organically the first positions is with many user research of the website and this requires a long time.

3.4. Email marketing

Email marketing is a formidable marketing channel that leverages email to advertise the goods or services your company offers. Email marketing is a type of direct marketing as well as digital marketing. By incorporating it into your marketing automation initiatives, it may assist in informing your clients about your most recent products or offers. Through various forms of marketing emails, it may also be extremely important in your overall marketing strategy for lead generation, brand recognition, relationship development, and consumer engagement in between transactions.

Due to the fact that emails remain in the inbox until they are read, deleted, or archived, email has grown to be a very popular marketing tool for companies. Email marketing help establish a connection with the audience and increase traffic to blog, social media

accounts, and other websites it is wanted that people visit. To ensure that consumers are only receiving the content they wish to view, it is possible to segment emails and target users based on demographics. By employing email marketing software that can also be set to simply send out emails, it is possible to use email marketing to do A/B tests on a subject line or call to action to determine the best performing message.

There are certain negatives to email marketing, despite the fact that it appears like the ideal approach to connect with clients, find new prospects, and strengthen crucial business ties. Some of these include the potential for the email to be marked as spam, the potential for an excessively big email to take a long time to load, or the potential for one-time user involvement (Mailchimp, 2022).

3.5. Social media marketing

It is important to understand how data can be collected in order to gain all the information required to communicate efficiently with customers, but it is fundamental as well to understand which tool can be used in order to reach the desired target. One of these tools are social media.

These offer a media mix approach that integrates with various channels and tools (Customer Relationship Management, e-mail, e-commerce, website), as well as being constantly and everywhere present with one main goal: listening to customers and their needs, social networks, in fact, regarded as real support for the company strategy (Sturiale & Scuderi, 2011).

3.3.1 Social Media numbers

Worldwide, there are 4.70 billion social media users corresponding to 59% of the total global population, potential customers who, on the web, look for information and then buy. In Italy, the percentage is higher considering that 71.6% of Italian internet users (corresponding to 43 million) belong to a social network. In the Italian scenario, for instance, e-commerce mixed with social networks, allow interesting opportunities for development (Global Social Media Statistics, 2022). In particular, it may be easier for Italian companies to transmit values such as quality, authenticity, and traceability, thanks

to Made-in-Italy products. Made-in-Italy is, nowadays, one of the most world-famous brands and these can give advantages, such as expanding abroad, even to small medium enterprises (Sturiale & Scuderi, 2011).

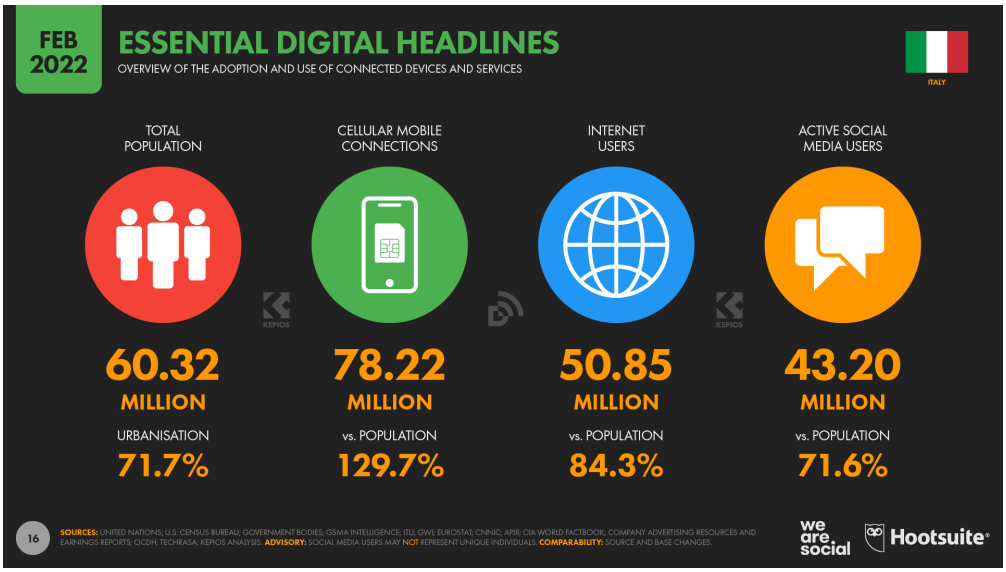

Figure 13 - Essential digital headlines in Italy, Source: Global Social Media Statistics, 2022

Social media permit companies to be more transparent with customers allowing people to effectively see where the food comes from through posts, stories, and videos. Nowadays, trust and influence are increasingly prevalent in personal connections and relationships. Social media platforms provide a strong foundation for businesses to develop their brands, considering also that marketing is a powerful and low-cost tool.

3.3.2. What is Social Media Marketing?

Due to the historical reliance of marketing on local and regional markets, social media marketing is different from conventional techniques. As a result of this, businesses become vulnerable to economic instability. Social networks, however, enable firms to overcome regional limitations and reach more people. Additionally, it permits two-way communication with clients, allowing businesses to better respond to their inquiries and interests regarding their goods and services. Thanks to social media, customers may ask questions without feeling embarrassed as they might in a physical store, rapidly receive answers to their questions, and express their opinions (Son & Niehm, 2021).

Consumers are now less inclined to base their purchases on the traditional purchase funnel as a result of the emergence of social media platforms and media fragmentation. Influence is increasingly more important to consumers than conventional marketing strategies and campaigns when making purchases. Instead, they are more prone to base their choices on their own beliefs, influenced by information from social media than by firm-initiated marketing (V. Kumar et al., 2017). This is correlated with the concept of "humanizing brands". Instead of using inanimate objects, it is preferable for customers to be passionate about a brand. This boosts its performance by fostering more positive consumer views (Gensler et al., 2013).

Small companies have the capacity and chance to develop these long-lasting relations with customers. Because it offers a network that may expose small businesses to a large number of new clients and develop their established audience in an affordable and efficient way, social media marketing is becoming increasingly beneficial to small businesses and extremely helpful due to the fact that it allows them to gain brand awareness. However, for small company owners, the main issue is successfully engaging with clients with limited funds. These businesses sometimes have limited resources, so using social media to improve marketing and consumer outreach may be appealing (Schaupp & Bélanger, 2014).

Participation in brand communities, according to research, increases consumer profitability and fosters better brand engagement, loyalty, and buying intentions (V. Kumar et al., 2017).

In the current era of social media, the agri-food sector cannot ignore the changes that social media has brought to business communication.

3.3.4. Social Media Marketing in the Agri-Food sector

The fundamental forces behind the hype around agri-food sustainability challenges are expected to be reinforced by the dynamics of social media engagement, such as personalization, amplification, polarization, and information dissemination through networks. First of all, social media is crucial for releasing or disclosing fresh information. Information about food production is more freely accessible because of user-generated content, such as films and images taken with mobile devices and uploaded on social media. The public and news media are interested in this new information since agri-food

systems lack openness. Social media may enhance the interpretation and transmission of information when it becomes publicly available. On social networks, group creation and customization of information can result in disputes between communities and echo chamber amplification. The social resonance of agri-food sustainability challenges might rise when emotive statements on social media circulate more quickly (Stieglitz & Dang-Xuan, 2013). Particularly emotionally charged and of general interest is the topic of food safety (Anderson, 2000), which has the potential to garner significant media coverage. News typically spreads throughout online groups, even if separate discourses might emerge in various virtual communities. Due to these factors, as well as the global character of social networks and the food system, a local problem may easily become international news. The sharing, like, and retweeting on social media contribute to the quick dissemination of homogeneous information and the self-referential dynamic of the media. Additionally, the collection of agri-food-related material currently present in digital media can be connected to the problem and given additional context through social networks, resulting in a news item.

Massive amounts of information are generated by social media users, creating new resources for communication and decision-making. Although social media public communication acts as a source of information for all players, significant degrees of knowledge, information technology, and financial resources are required to fully utilize social media data. Additionally, social media is best for merchants as a platform for marketing and advertising. Large food merchants are at the forefront of data mining in the agro-food sector and use it to predict and shape consumer preferences as well as to direct the public conversation on food and sustainability (Stevens et al., 2016).

The company should take into account using social media for green efforts because it might result in a number of advantageous outcomes (Matthew, 2011d). When an individual or a company is developing and improving its sustainable green identification and actions, social media may provide numerous beneficial advantages. The following suggestions are provided in a spirit of positivity and support for sustainability and green efforts to make sure that media platforms use is effective and beneficial in that it helps to strategic innovation and management, including planning, implementation, and control:

1. Plan your social media campaigns for green marketing, and then establish attainable targets. Measure results to ensure success and for control objectives (The Green Marketing Company, 2011a);
2. Inform others about your good citizenship and your commitment to environmental sustainability. Promote your business, environmental services, learning, teamwork, performance, and advancement (Matthews, 2011d);
3. Be truthful and engage with your audience frequently and freely about relevant issues (LeCompte, 2010);
4. Create a network of brand aficionados and even evangelists. 28% of bloggers share their thoughts on goods and companies. You must be aware of your brand identity in order to do this (LeCompte, 2010);
5. Recognize which issues are most significant to your audience. You may then concentrate on customer persuadability that is pertinent to your target (Marketing Green, 2012) "People often buy green products for the feel-good vibe that comes with the purchase. Events that enhance this vibe and create a memorable experience can generate a positive buzz around a brand. And when amplified through social networks, this buzz can generate significant financial rewards." (Williams et al., 2014);
6. Target these particular niche markets by identifying microsegments through research; for example, target new visitors and influencers (Marketing Green, 2012);
7. Target younger users. They are more likely to be involved in and take action on green projects since they have wider social networks. A friend's social networking post prompted 14% of 18 to 24-year-olds to switch to a more ecologically friendly product, according to Mintel's study. About 13% of this demographic reported liking a business on Facebook (these users frequently have more than 300 friends), following a business on Twitter, or pinning the business to their Pinterest board as a result of the business's green policies (Williams et al., 2014).
8. Although social media is offering numerous new ways to gather and disseminate information, its claim to fame is in fostering connections built on shared goals and benefits. These can be used to increase client loyalty (Williams et al., 2014).
9. Make followers and supporters into motivators for their friends (Williams et al., 2014).

10. When it comes to social media, marketers should discover straightforward ways to modify a person's attitudes that appeal to emotions rather than rational thinking if they wish to succeed in changing consumer lifestyles to more environmentally friendly practices. (Marketing Week, 2012)
11. Instead of concentrating on the advantages that go to the firm for its sustainable efforts, emphasize the financial benefits of sustainable living that are received by customers (Williams et al., 2014).
12. Encourage target customers to test your brand by directing them to your website with discounts, promotions, and environmental information (Williams et al., 2014).
13. Promote your environmental contribution and spread awareness of green efforts by using podcasts, interviews, or webinars (Howell, 2009).
14. Social networks can be used to deal with environmentally friendly businesses, but keep in mind your basic comparative advertising principles, such as always comparing up and never comparing down, customers dislike it when you criticize the competition (Matthews, 2011d).
15. While sharing updates, photographs, videos, and articles on social media might increase traffic, it has no positive effect on search engine results. Therefore, it is crucial to increase visitors to your website as this has an effect on search engine results (Matthews, 2011d).
16. All websites that engage in green marketing must have high-quality videos. Videos are 53 times more likely than other Web pages to show up on page 1 of search results, according to a new Forrester Research analysis. Therefore, provide a video outlining your goods and services (Hannam, 2010).
17. Combine your traditional and online marketing strategies. For instance, interactive technology and gaming elements are enabling brands to combine outdoor advertisements with experiential and new media activity (Marketing Week, 2011).
18. Consider your social media campaign's price, length, and metrics differently. The results of an interactive campaign could not be seen for several months. However, active users may imply that the application may last a very long period with relatively little upkeep (Williams et al., 2014).

Chapter 4 “Empirical analysis”

4.1. Materials and methods

In this complex period of transformation and transition of the Italian industrial sector and in the face of the need to best set up the post-pandemic restart, the focus of this analysis is to understand the competitiveness of the Italian agribusinesses. In particular, the aim is to understand which companies that work in the agri-food business are adopting innovative solutions, such as smart technologies and digital marketing strategies, and how many activities related to sustainability they carry out.

There is not much recent research related to digital transformation in the agri-food sector. There is a lack of information about digital marketing and how it can effectively change consumer preferences to lead them into greener purchasing or, more in general, a greener lifestyle. For this reason, this thesis aims to discover more about the correlation between innovation and digital sustainability in the agri-food sector and give a stimulus to research more about it. In order to better investigate these topics, the following research is based particularly on chapters 2 and 3.

Firstly, in collaboration with the Digital marketing & food Observatory, a mapping on the use of digital tools in marketing was carried out in February-September 2020 with reference to a sample of food SMEs in the Triveneto area. The sample surveyed was drawn from the AIDA-Bureau Van Dijk database. Only corporations with between 10 and 250 employees (SMEs according to the ISTAT classification) and budget availability for the year 2018 were considered. The extraction referred to all ATECO codes from 10.1 to 10.8, excluding beverages. The sample consists of 520 companies. However, my analysis focuses on the ATECO code 10.8, which corresponds to “Production of other food products”, with a final sample of 79 companies. The analysis aimed to map the companies' online presence. It concerned the collection of information on proprietary online spaces (websites, social networks, etc.), and the various practices.

The second step of the analysis provided for the online administration of a structured survey with predominantly closed answers on a sub-sample of companies with a digital

presence in order to obtain information on the strategies of companies in general and on their decisions relating to digital marketing and sustainability. 14 companies of the 79 participants fully replied to the survey.

The survey was divided into four sections. In the first section, it was asked for general information such as companies' master data, invested percentage, market type in which companies work, companies' performances, and post-Covid-19 performance. In the second section, the objective was to find the innovation rate in the company. In the third section, the focus was on digital transformation and Industry 4.0 with the aim to understand how many companies in this field adopt smart technologies and digital marketing tools. It was also relevant to investigate if firms followed a well-defined strategy if they hired new people with digital skills, which people were involved in this process, at which point of the digital transformation process companies were, and how digital transformation influenced the recent sanitary emergency. Another important aspect to focus on was how firms use the data generated from digital tools. The last section was related to sustainability since the objectives of sustainability are a central aspect of European policies to boost the economy and due to the perceived importance of the consumer in this matter. Precisely, the focus was on the type of strategy the business adopted in recent years or what are their objectives in the next few years, which certifications they received, which financial documents are adopted, and whom the subjects involved entrusted in dealing with sustainability aspects.

The third part of the analysis was carried out through in-depth interviews with 3 of 14 companies within the company who is responsible for marketing activities. It had the objective of obtaining information on the following topics: general information about the company in the target market, investments of the company in digital transformation and sustainability, digital activities management, and sustainability.

4.2. Characteristics of the sample

The sample of the research is composed of 79 participants whose 78,5% from Veneto, 12,7% from Trentino Alto Adige, and 8,9% from Friuli Venezia Giulia.

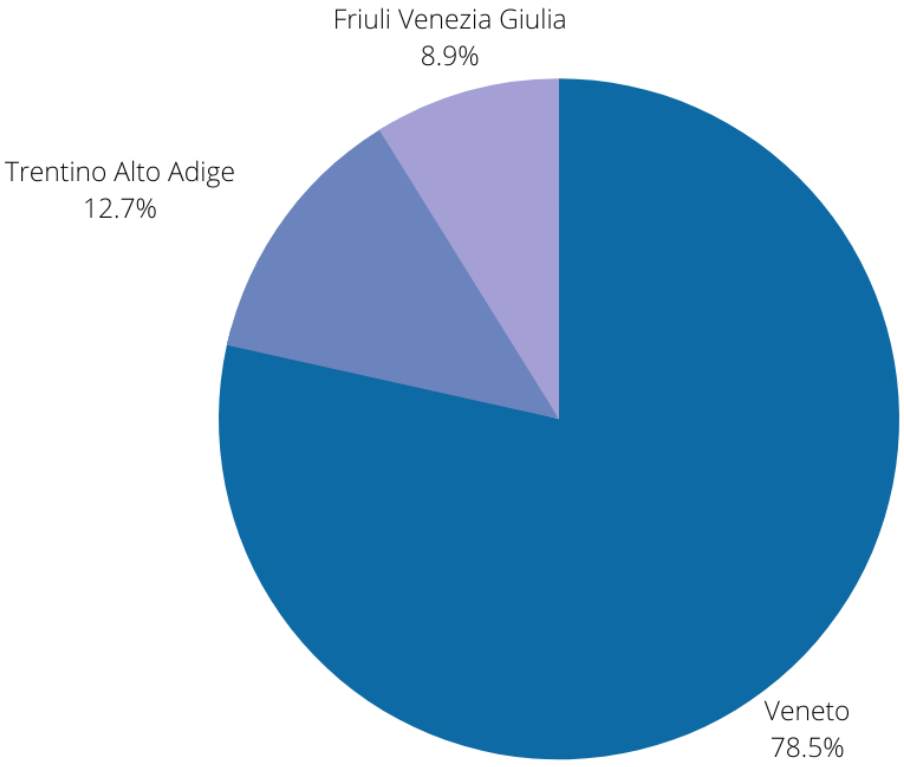

Figure 14 – Region of origin of the companies, Source: data processing

The largest percentage consists of companies with less than 50 employees but more than 10 (77,8%), followed by companies with more than 50 employees but less than 250 (17,5%) and then companies with less than 10 employees (4,8%).

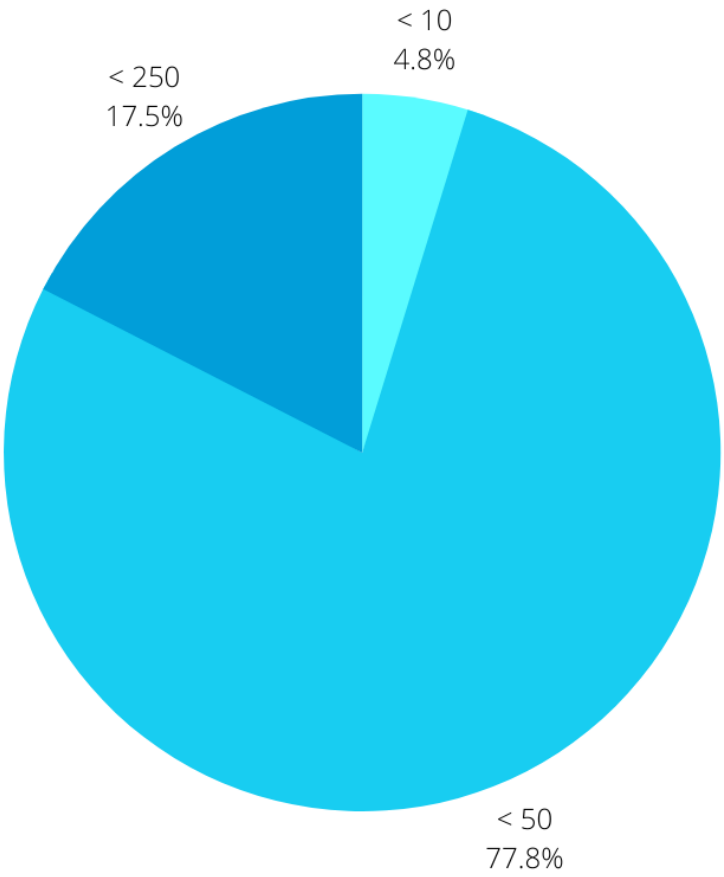

Figure 15 - Size of the company, Source: data processing

Regarding the type of market in which the sample companies operate, it can be seen that 34 percent sell their products in B2B, 22.8 percent sell in a B2C condition, and 19 percent operate in both sectors, namely, B2B/B2C. 24.1% did not indicate their target market.

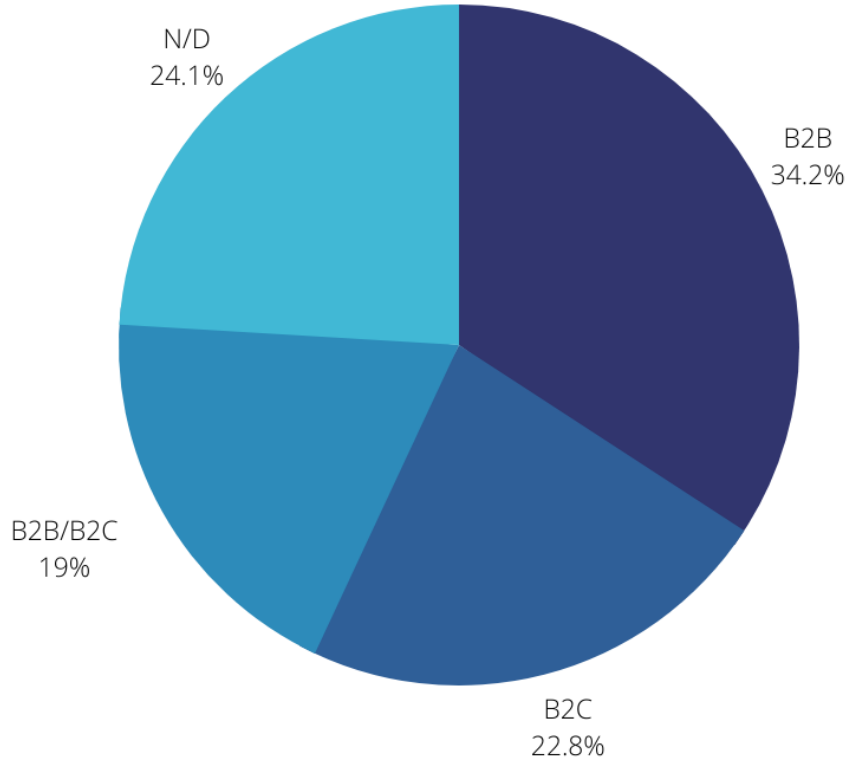

Figure 16 - Type of market, Source: data processing

4.3. Survey results

In this paragraph, I will illustrate the results in general terms of the survey submitted to 79 companies of the data desk but fully completed by 14 companies.

First of all, I sum up the results of the general information of the survey. I consider the percentage of investments of revenues in R&D and in foreign markets and divided the results into four brackets, namely 0-10%, 10-30%, 30-50%, and >50%. Eight companies invested a percentage of revenues in R&D between 0% and 10%, three companies between 10% and 30%, one company invested a percentage of revenues between 30 and 50%, and zero over 50%. Regarding the percentage of companies invested in foreign markets, it is possible to see that four companies invested a percentage of revenues in foreign markets between 0% and 10%, 4 companies between 10% and 30%, 2 companies between 30% and 50% and 2 over 50%.

INVESTIMENTS				
	0-10%	**10-30%**	**30-50%**	**>50%**
% Invested in R&D	8	3	1	0
% Invested in foreign markets	4	4	2	2

Table 1: Percentage of investments of revenue in R&D and in foreign market. Source: data processing

Then, I analyzed the economic performance of the companies in the period 2016-2019 about turnover, profit and average margins. It is possible to see that ten companies increased its turnover, for one remains constant and three has seen shrink the turnover. The profit increased for eight companies, for four companies remain constant and for two companies the profit decreased. The average margins increased for seven firms, five companies remain constant, and 2 businesses decreased its average margin.

ECONOMIC PERFORMANCE IN THE PERIOD 2016-2019			
	Increased	**Constant**	**Decreased**
Turnover	10	1	3
Profit	8	4	2
Average margins	7	5	2

Table 2 - Economic performance of the companies in the period 2016-2019. Source: data processing

After that, I analyzed the economic performance of the companies after 2020 considering the Covid-19 about turnover, profit, and average margins. It is possible to see that six companies increased its turnover, for two remains constant and six has seen shrink the turnover. The profit increased for four companies, for four companies remain constant and for six companies the profit decreased. The average margins increased for two firms, five companies remain constant, and 7 businesses decreased its average margin.

ECONOMIC PERFORMANCE AFTER 2020 (COVID-19)			
	Increasing	**Constant**	**Decreasing**
Turnover	6	2	6
Profit	4	4	6
Average margins	2	5	7

Table 3 - Economic performance of the companies after 2020. Source: data processing

After the general information, the attention was shifted to the rate of innovation of the participants since, from the analysis of the data desk, it resulted that 95% of companies have a website while the 36% have e-commerce.

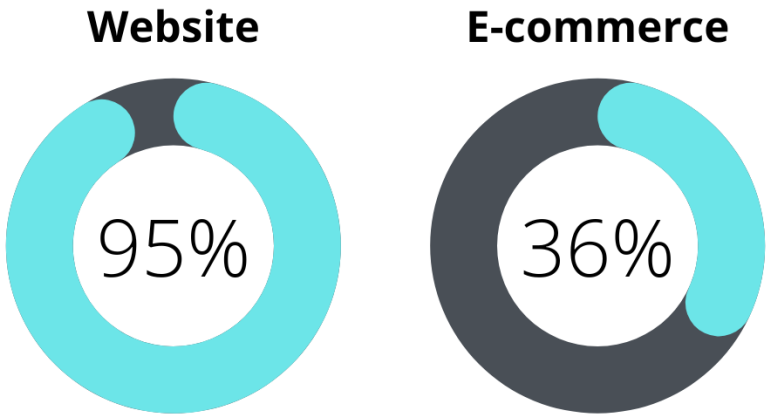

Figure 17 - Digital tools of companies, Source: data origins

Moreover, regarding social media, it was asked how many of these were used. It is possible see how the range is from 0 to 6 types of social networks. In detail, the donut chart shows that most of the companies surveyed do not even have a social media profile (24.1%), followed by companies that have 3 different types of social media (22.8%), 16.5% have 2 types of social networks, 1 and 4 (both 11.4%), 8.9% have 5 profiles, and 5.1% use as many as 6 different types of social media.

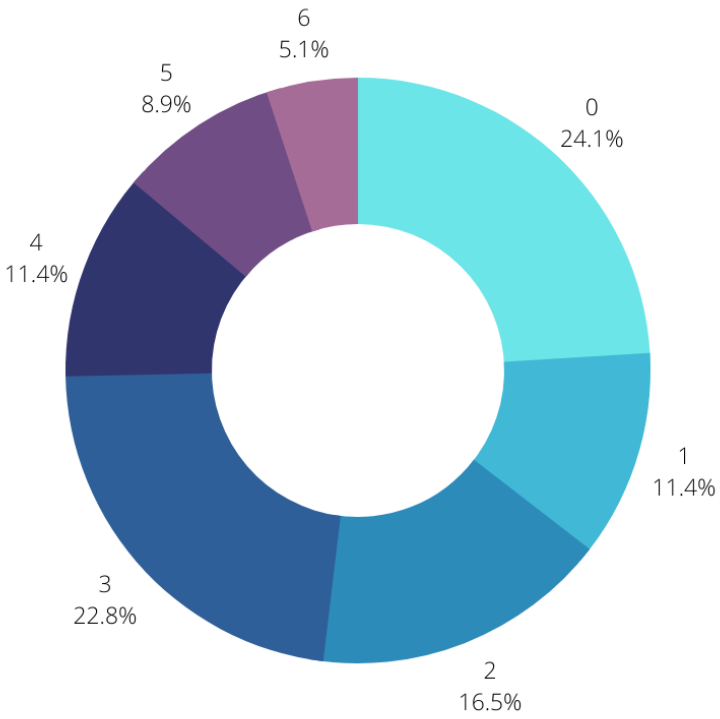

Figure 18 - Number of social media used by companies, Source: data origins

Taken into consideration these two factors, innovation of the companies that fully completed the survey was investigated. Four companies agree to adopt new technologies when they are launched in the market, five companies fairly agree about the adoption, four neither agree or disagree and one disagree. Then, eight companies agree that employees are trained about how to use new technologies, four fairly agree, one either agree or disagree and one disagree.

INNOVATION				
	Agree	**Fairly agree**	**Neither agree nor disagree**	**Disagree**
Adoption of new technologies when launched in the market	4	5	4	1
Employees are trained about how to use new technologies	8	4	1	1

Table 4 - Innovation. Source: data processing

The innovation is linked to digital transformation and industry 4.0, another aspect I wanted to highlight.

It is possible to see that eight companies digitalize themselves between 2016 and 2019, four companies after 2020, one company before 2016 and one company never.

	Never	< 2016	2016 - 2019	>2020
Year of digital transformation	1	1	8	4

Table 5 - Year of digital transformation of companies. Source: data processing

In addition, I analyzed the influence of the pandemic on digital transformation. Seven companies said that the pandemic has neither affected nor influenced, three nothing, two a little, and two a lot.

	A lot	A little	Neutral	Nothing
Influence of the pandemic on digital transformation	2	2	7	3

Table 6 - Influence of the pandemic on companies' digital transformation. Source: data processing

In the table below, it is sum up the adoption of technologies by the companies divided into those who adopt them, "yes", those who do not adopt them but they will in the coming years "no, but...", and those who do not adopt them "no". It can be seen that most companies do not adopt the technologies highlighted in the table.

Technologies	No	No, but ...	Yes
Sensorized and networked production plants	2	1	11
Additive manufacturing	9	0	3
Augmented reality, virtual reality, product/process/plant simulation software	11	1	1
Internet of Things	10	2	2
Cloud system	5	0	9
Cybersecurity and business continuity	5	1	8
Big data/Analytics	8	1	5
Supply chain management information systems and coordination with suppliers/logistics operators	6	3	5

Predictive maintenance systems to anticipate line failures and malfunctions	5	4	5
Traceability systems for finished products and raw materials	1	13	4
Product life cycle management systems	4	1	9
Systems for predicting problems and disruptions in supply chains	5	2	7
Algorithms for logistics management	7	4	3
E-commerce systems	6	2	6
Mobile/via internet payment systems	4	2	8
Geolocation systems	9	2	3
CRM system	7	1	6
Technologies for the in-store customer experience	9	3	2
RFID, tracking system	8	1	5
EDI system	9	1	4
Digital marketing system (Social media, SEO, SEM, ...)	5	2	7
App	8	3	3
TOTAL	**143**	50	116

Table 7 - Technologies used by companies, Source: data processing

The last part of the survey focused on sustainability. It was asked to participants to declare figures in charge of sustainability in the next 1-2 years. Six companies have a figure about environmental responsibility while eight do not. Four companies have a figure about social responsibility while ten do not. Four companies have a figure about CSR responsibility while 10 do not. Two companies have a figure about diversity/inclusion responsibility while 12 do not. One company has 1 figure engaged in other responsibilities while thirteen do not.

FIGURES IN CHARGE OF SUSTAINABILITY IN THE NEXT 1-2 YEARS		
	YES	**NO**
Environmental responsibility	6	8
Social responsibility	4	10
CSR responsibility	4	10
Diversity/inclusion responsibility	2	12
Other responsibilities	1	13

Table 8 - Figures in charge of sustainability in the next 1-2 years. Source: data processing

It was also important to illustrate how many companies adopt financial documents related to sustainability. One company adopts the sustainability report and thirteen do not, four companies adopt the integrated report and ten do not, no one adopt the social report and five companies adopt the non-financial reporting report and nine do not.

FINANCIAL DOCUMENTS		
	YES	**NO**
Sustainability report	1	13
Integrated report	4	10
Social report	0	14
Non-financial reporting	5	9

Table 9 - Financial documents. Source: data processing

In addition, the following table summarizes the sustainability practices adopted by the surveyed companies divided into those who adopt them "yes", those who will adopt them in the coming years "yes, but...", and those who do not adopt them "no". It can be seen that most companies adopt sustainability systems.

Sustainability systems	No	Yes, but ...	Yes
Packaging with environmentally friendly materials	5	5	4
A monitoring of the supply chain for sustainability	4	5	5
A management/valorization of waste	1	3	10
The use of renewable energy	5	2	7
Energy efficiency systems	5	2	7
Systems for reducing emissions (Green House Gas)	7	7	5
TOTAL	27	24	**38**

Table 10 – Sustainability systems adopted by companies, Source: data processing

4.4. Case study: +Watt S.r.l.

+Watt was founded in 1977 in Padua, Veneto. It is a company that develops, manufactures, and markets dietary supplements primarily for the sports world but also for daily wellness. The mission of the company is to give the best quality to the customers, from the customer service to the product. As a matter of fact, development and production are internalized to guarantee food safety and quality. Consequently, +Watt can boast of "made in Italy" excellence. The founding values that have always guided +Watt's choices are, therefore, the pursuit of quality, the preservation of health, and the improvement of the sports experience and performance.

This firm is part of the ATECO code 10.8 “Production of other food products”. It has 40 employees, and it works primarily in the B2B sector. It owned one website and one e-commerce, and it is present on three social media channels. The interviewed person is the marketing manager of the company.

4.4.1. General information about the company in the target market

Having a deep-rooted strength in the territory, which has also been the main and only sales channel for many years, it has retailers as its main interlocutors. Specifically, there are pharmacies, personal trainers, sports stores, specialty retailers, and online stores; in the experimental phase is the inclusion of some references in selected facilities that are part of the large-scale retail trade. With the advent of the web and online stores, the company +Watt has opened its own official online store with the resale of the complete catalog, creating a sales alternative linked to service and offer.

+Watt, in today's supplement market, is in the mid-to-high range; except for some references in the catalog where it is not scientifically impossible to guarantee the same quality assurance at a lower price. It is a company that can boast full control of the entire supply chain, from the purchase of raw materials to the marketing of the finished product.

This is an advantage at the expense of those who cannot guarantee what is inside the jars because they outsource production or buy low-quality raw materials to cut costs.

The main competitors are first and foremost the Italian manufacturers of sports nutritional supplements and the realities that market trademarked sports supplements. As far as online is concerned, a conflict comes into play with the same customer retailers who also have resale on the web, through marketplaces or proprietary e-commerce, which inevitably clashes with the second sales channel, the website of +Watt.

Related to the organization of digital activities, +Watt is well structured. There is a marketing office that deals with digital and offline marketing strategies. These are planning the editorial plan for social media, and newsletters, monitoring sponsored people, evaluating sponsorship proposals, organizing events, implementing social campaigns, designing the graphics of packaging and various print media for offline communication, website and e-commerce management, and SEM management. However, it required the intervention of external agencies as the role of consultants. Such agencies are a SEM agency, a website agency, a graphical agency and a video making agency.

On the contrary, the sustainability aspect is not very much taken into consideration. There is no internal person or team dedicated to such matters, there is only an external consultant that keeps the company updated about the regulation to comply with.

4.4.2. Investments of the company

Digital investments are fundamental for this company since most of the activities depend on them. Most of the smart technologies used by the company are cloud-computing related. +Watt works with a company that offers many services, such as an Enterprise Resource Planning (ERP) management system, cybersecurity, and a management system that connects e-commerce to available products in the warehouse. Thanks to ERP, for instance, electronic devices such as computers, tablets, and smartphones, are connected to a cloud where there are servers that divide all the departments of the company. Inside each server, for instance, it is possible to insert files or whatever that department needs to work on. In this way, it is easy to access information from any location at any time and there is an organized interconnection.

Another type of smart technology exploited is Big Data. These are used to measure the e-commerce performance, user profiling, social adv results, etc. Inevitably, Big Data and cloud computing systems work together.

Most of these technologies were already present when the Covid-19 pandemic broke out. It is also true that this event prompted the company to digitize more. One example was redoing the website and improving e-commerce.

4.4.3. Digital activities management

+Watt has a corporate presence on Facebook, Instagram, LinkedIn, and YouTube, as well as a managed presence on Google. Currently, there is no strategic management through LinkedIn, but an 'institutional' presence, while YouTube will be used, in addition to being a container channel, as an advertising channel. Facebook and Instagram are currently the social channels that are considered most important, and consequently, with more targeted strategic management in terms of communication and advertising.

The Socials that +Watt gives the most weight to measurements in the strategic sphere are Facebook and Instagram themselves together with Meta Business Suite. In general, the data analyzed to understand performance are follower trends, engagement rate, comments and shares, coverage, and the number of interactions with users. Sponsored campaigns are, however, analyzed differently. On some campaigns, ROI is quantified, as they are linked to the website via pixels, although data is very sparse due to restrictions in terms of legislation related to the use of cookies for tracking. On a monthly basis, a report is compiled with key KPIs related to overall and sponsored-related performance, based on routine weekly analysis.

The company reputes that actual social network profiles are in line with the target audience desired they want to reach. However, they are open to new opportunities, and they are considering landing on Tik Tok with a studied strategy.

Web and Social mentions are periodically analyzed, comments on Social are managed internally daily, and comments related to our products in external marketplaces, and retailer shops are analyzed. Spontaneous reviews on Google and any tracks on YouTube are also displayed.

The e-commerce channel was opened about 12 years ago, initially to create an alternative for that part of customers who prefer to buy from the web, also using the site as a catalog, and to give a complete service and an additional tool to the commercial network. In 2022, an investment was made to update the site, from graphical to structural restyling, changing the platform and making it part of a strategic plan that will bring it more and more importance within future business objectives. Without competing with its retailers, but focusing on content, transparency, and services. For the first few years, revenue from this channel was never given due weight, as it was never the first and most important channel. With the pandemic, the scenario changed. Consumers' habits have changed and the need to value this channel has been realized, and it has recorded almost the same revenue from 2020 to date as all previous years, increasing the conversion rate by 50 percent.

The website is included in a strategic plan that includes its promotion through the Google Ads ecosystem, through the sponsorships and editorial plan of Facebook, Instagram, and LinkedIn. It is included in print communication, and in all advertising and promotional media. In addition, through an SEO plan aimed at optimizing the positioning of the same site organically through content, a slice of users will inevitably land on some page of the site finding the answers to the questions posed on the web.

The initial difficulties, not having the in-house know-how, were interfacing with outside agencies that managed its online presence, adapting to new regulations regarding the web world, understanding its dynamics, and trying to be competitively attractive in a rapidly changing market. Furthermore, there are some problems with the traditional sales network as some retailers see the website as a "competitor" that can potentially take away sales.

The main metrics that are monitored are mainly the results related to audience and visits, to understand the target audience browsing the site, data related to the sources from which the audience comes from are analyzed in order to understand possible room for maneuver to increase visits, the user journey in relation to sessions and various behavior flows are analyzed, in order to make changes and improvements to enhance the user and shopping experience, data related to e-commerce such as conversion rate, average order value, transactions, items sold and coupons used are analyzed daily, as well as all the results related to the various marketing actions that are carried out in parallel.

4.4.4. Sustainability

There are no sustainability activities implemented in these years but there are two main ongoing projects, one with the aim of substituting the actual packaging with more ecological ones, and the other one is related to the adoption of renewable energies.

There is also to be said that there is no particular push from customers to adopt particular practices related to sustainability.

4.5. Case study: Surgenuin S.r.l.

Le migliori delicatezze Surgenuin pronte da portare in tavola

Surgenuin was founded in the 1970s in Treviso, Veneto, as an artisan workshop specializing in snail processing. The experience and the commercial success have turned the firm into the leading company in the snail processing sector in Italy and have brought us to develop new products marked by the typical Venetian and Mediterranean flavors. The goal of the company is to release wholesome and traditional cuisine, preserved by the cold and ready for use, with Surgenuin products.

This firm is part of the ATECO code 10.8 “Production of other food products”. It has 15 employees, and it works mainly in the B2B sector. It owned one website and one e-commerce, and it is present on three social media channels. The interviewed person is one of the owner of the company.

4.5.1. General information about the company in the target market

The target markets are mainly companies that work with frozen products, festivals, and events. By producing niche dishes typical of the Veneto region's tradition, Surgenuin is positioned in the medium-high range compared to its competitors because the raw materials used to meet high-quality standards, as do the product's manufacturing processes, consequently increasing the price.

Surgenuin decided to differentiate the brand under which it sells the products to the b2b sector, with a brand under which it sells to end consumers. The name of the latter is “Nordy” from which the social profiles and e-commerce are named.

Digital activities are managed externally. The company does not aim to advertise the brand Surgenuin but rather focuses attention on the product. This choice is due to the fact that Surgenuin is not, for example, on supermarket shelves and more generally not present in b2c markets. The marketing strategy depends on the period since frozen products follow seasonality and so do marketing campaigns.

Sustainability activities are managed internally by the owners of the company since is an important theme for them. Nevertheless, the company collaborates with extern consultants to remain updated with new sustainable projects.

New people related to the digital transition have recently been hired both directly and indirectly. It is interesting to note that the digital transition itself, is for the most part the hiring of personnel in departments not directly related to the digital transition, are nevertheless connected since the digital transition itself is for the most part responsible for such hiring.

4.5.2. Investments of the company

The digital transformation in the production and management process is a strategic choice for Surgenuin. Most of smart technologies are IoT based but there is also the presence of cloud-computing system and big data analyses. All systems are integrated with each other in order to guarantee the complete and instantaneous availability of both process and product information at any time and for each batch of production, allowing in a matter of seconds to fully trace the batches of raw materials used, the production process data and the list of customers to which each batch of finished product was delivered. Below, some examples:

- A computerized cooking system using diathermic oil, which allows any kind of cooking even without the constant supervision of the staff. For each stage of the recipe, a dedicated temperature management curve is studied and developed, to automatically regulate, manage, and optimize the cooking process.

- IQF (Individually Quick Frozen) freezing plant, unique in its kind, designed, built, and certified by Surgenuin itself. The plant allows to obtain product lots that are easy for consumers to cut up into portions, easy and quick to prepare. The first step of freezing occurs at -110 °C, ensuring immediate cooling of the product without damaging the structure of the food and preserving all the organoleptic and nutritional characteristics of the product.
- A system that manages, controls, and tracks the production process, constantly monitoring the parameters provided by machinery and refrigeration cells.
- A system that manages, controls, and tracks the production process, constantly monitoring the parameters provided by machinery and refrigeration cells.

Regarding the digital aspect of marketing, the company invests by relying on an external agency.

From this, it can be understood that this company has always been attentive to digitization. In fact, covid-19 has not given a particular push to further digitize itself except for e-commerce, which despite being a project prior to the pandemic, has inevitably become a project of primary importance.

4.5.3. Digital activities management

The company is present on three different social media, namely Facebook, Instagram, and LinkedIn. Moreover, the company uses Google Ads and newsletters as digital channels. The use of the latter is mainly to wake up dormant customers, so if the user does not order for a certain amount of time an email is sent with a discount code. Furthermore, an informative newsletter project has recently started.

Facebook is the most used social network, in second place is placed Instagram, while LinkedIn does not yet have a communication strategy, in fact, no posts have yet been published. Since the Facebook page is the one on which you invest the most and also has an audience more in line with the products offered, it performs better from the point of view of ROI and number of engagements, and number of followers.

Initially, the communication strategy used on social networks was aimed at making the brand known, now the most used strategy is to push the user to insert the products in the cart and consequently to purchase. Although social channels are very effective for the

company, the most powerful digital marketing tool is Google thanks to the implementation of SEO and SEM campaigns.

The desire to continue investing in digital marketing campaigns was confirmed by a recent failure of an offline marketing campaign. The company has invested in 150,000 flyers with discount codes to use on the website and has them distributed in 3 different municipalities. The result was 0 sales.

The results of the digital strategies are provided by the external agency through monthly reports. It is then up to the manager of the company to give guidelines on how much to invest and the modalities.

E-commerce was born as a need following the huge sales volumes of the company shop and to provide the end user with an additional service. Hence, the performance is excellent and exceeded expectations.

The main limitation is the lack of an adequate distribution network for frozen products. This means that the company must organize itself with private couriers. This also has a reflection on the type of service offered because, although it is efficient in most cases, the fact that couriers are not like GLS, UPS, or similar, they do not have the same degree of attention towards the customer.

Regarding the monitoring of e-commerce results, they can be monitored by the manager.

4.5.4. Sustainability

The company has always seen sustainability as an aspect that in the long run would reward the initial efforts and investments.

From the point of view of energy recovery, Surgenuin is able to recover almost all of the heat from refrigeration systems that are used to heat the domestic water used in product processing. By doing so, they save methane that they would have to use to heat the water. The same principle is used on the flue gas from kitchen boilers used to cook the products. In doing so, a good portion of the domestic water is heated by these methods, allowing savings to be made. They also use photovoltaic panels to cover part of the energy needs. Another project is for a new environmentally friendly deep-freezing plant (this is an investment).

Most customers are attentive to sustainability even if, according to the manager of the company, it is not a factor that would particularly influence sales.

4.6. Case study: Dersut Caffè S.p.A.

Dersut Caffè S.p.A. is a historic roasting company based in Conegliano, Veneto, Italy, founded in 1949 by Count Dr. Vincenzo Caballini of Sassoferrato. Dersut has always pursued the pursuit of quality not only of the product, but also of the entire production process and company organization, searching, directly in the production areas, for the best coffee qualities available, purchasing the right crops, ensuring technology, and carrying out constant controls, which guarantee compliance with the quality standards set for each production phase: from roasting to packaging, and distribution. In continuous and constant development, Dersut has designed and built the Coffee Museum. In addition, Dersut Caffè is among the founding members of the "Consortium for the Protection of Traditional Italian Espresso Coffee." In 2014, the "Oro Top Quality" blend was awarded the Golden Medal at the International Coffee Tasting promoted by the International Institute of Coffee Tasters. In the same year, the company became a member of SCAE (Speciality Coffee Association of Europe), a UK-based association that promotes quality coffee culture and coffees of excellence in Europe. In addition, it is a member INEI (National Institute of Italian Espresso) and Narrators of Taste.

This firm is part of the ATECO code 10.8 “Production of other food products”. It has 40 employees, and it works primarily in the B2B sector. It owned one website and one e-commerce, and it is present on four social media channels. The interviewed person is the marketing manager of the company.

4.6.1. General information about the company in the target market

The main target channel is the HORECA (hotel-restaurant-café) sector to whom they sell their products, they owned 120 stores distributed mainly in the Veneto region managed independently, and the stores have to comply with some standard rules. Among sales channels, there are also foreign distributors that have the same rules as Italian stores. Then, there is a small percentage referred to the online market.

In the Italian cafe sector, there is a lot of competition (there are more than 800 roasters), despite this and excluding competitors that are part of the large-scale retail sector, Dersut is positioned in the medium-high range due to the quality of their raw material.

Digital marketing activities are organized both internally and externally. There is a social media manager inside the company that works with two external agencies, one deals with graphic design, and one is concerned with the website, e-commerce, google ads, newsletter management, and social content creators.

The main digital activities of the marketing agency are planning the editorial plan for social media, newsletters, monitoring sponsored people, evaluating sponsorship proposals, organizing events, implementing social campaigns, designing the graphics of packaging and various print media for offline communication, website, and e-commerce management, and SEM management. Moreover, the company did a rebranding in 2019 and so there are many activities focused on this (packaging modification, social marketing campaigns, etc.).

Nowadays, the company has an internal team of three people following the sustainability aspect. This is to adapt to new trends and a recent enrollment in the sustainability channel of "Assindustria." The sustainability process is supported by an external engineer and an external consultant from "Assindutria" who helps the company to draw up the sustainability report.

4.6.2. Investments of the company

The company did a rebrand in 2019, this took relevant investments in digital assets. The rebranding process is not finished yet as this takes time for various factors. Among them, is the fact that old branded products must be replaced with products with renewed packaging. Another factor is linked to brand awareness, it takes time for consumers to get used to the new graphic line.

The company is equipped with a methane heat generator, smoke burners, and a cyclone that prevents the dispersion of roasted coffee particles into the atmosphere. The union between technological knowledge and environmental sensitivity and a great ability to reconcile ethical and economic activities are some of the values that have managed to give Dersut great visibility and appreciation in the sector. Furthermore, the company has begun to build a new headquarters which will include an automated warehouse through a management system.

The covid-19 pandemic did not prompt the company to make new investments and digitalize itself more. The company decided before that to invest in new projects.

4.6.3. Digital activities management

The social media used by the company are 4, the social network page that performs better is Facebook, followed by Instagram, LinkedIn, and then Pinterest.

It is interesting to note that, according to the social media manager, the greatest response comes from customers who sell their coffee. These actively publish content in their social profiles giving great visibility, especially because the communication is less forced, and the end user perceives it as truer. However, the company has the will to broaden its target audience and therefore also bring the final consumer closer to the company. the company has the will to broaden its target audience and therefore also bring the final consumer closer to the company. To do this, an academy for coffee enthusiasts was created in order to educate them on how coffee is processed, how to distinguish a quality one, etc. The courses are held on-site but this project allows the firm to carry out targeted campaigns, especially on Instagram, to expand the audience.

There is an intention on the part of the company to land on Tik Tok but there is not yet a strategy formulated. What holds back the company is the way of communicating to be professional but at the same time communicating with a lower age target and not in line who would risk not appreciating the brand.

The results are monitored internally with google analytics and externally by the agency which provides a monthly report.

Since 2017 the company has opened e-commerce which has always performed as expected. There were no particular difficulties in development and management, and

indeed, during the pandemic, e-commerce sales skyrocketed. In addition, the company has seen an increase in online sales following the pandemic.

4.6.4. Sustainability

The participation to the “Assindustria” program has implied the subscription to “Too Good To Go”, well-known app useful to reduce waste, and the submission of the sustainability report. The company is attentive to the aspect of renewable energy and, in fact, has a photovoltaic system. In addition to this, the company has recently changed its electricity supplier to one that uses renewable energy.

The company is also engaged in a project both socially and environmentally sustainable that aims to eliminate part of production waste by donating them to children with difficulties for the creation of games or, more generally, objects that will be reused to extend the life cycle of certain materials.

The company collaborates with Welfare Care, a company committed to social issues, specifically for the prevention of breast cancer.

There have been no particular failures in terms of sustainability except with two projects One aims to replace the classic coffee coil which has a double layer of aluminum, but the problem is related to the fact that has not yet been invented reliable replacement and one is related to the creation of compostable capsules.

4.5. Discussion of results

Starting from the analysis of the results obtained from the data desk, it can be seen that most companies in the sample are small enterprises headquartered in the Veneto region operating in the B2B market.

Regarding the digital presence of the subsample belonging to ATECO code 10.8 analyzed, the results show that 36% of companies have e-commerce which, compared to the whole sample of the last report of the Agri-food Management and Innovation Lab of Ca' Foscari, increased by 10% circa. The social media presence is important data as well since the results demonstrated that most (24,1%) do not even have a social media profile. This data can make reflect as a non-existent presence on social networks could compromise the visibility and possible growth of the company. It is also true that a similar percentage (22,8%) is present in three different social networks.

Following with the analysis of the 14 surveys fulfilled by the companies, it can be seen that most invested between 0% and 10% of the revenues in R&D, and eight have invested a percentage of revenues no greater than 30% in foreign markets.

It is interesting to see how the economic performance of the companies in the period 2016-2019 and after 2020 considering the Covid-19 pandemic change. Overall, turnover, profit and average margins decreased after 2020. This is most likely linked to the pandemic itself.

Most companies have embarked on a digital transformation process in the period between 2016 and 2019. In fact, most of them considered the advent of the pandemic to be of little influence as an incentive to digitize since they started this process before. Most are quite in agreement about adopting new technologies when launched in the market and appropriately training employees in their use. However, albeit with a slight difference, it can be seen that companies that do not adopt the technologies shown in table 7 outnumber those that do.

Moving to the theme of sustainability, it is clear that most companies do not have figures in charge of this aspect and do not prepare financial reports related to sustainability. However, it is possible to note in table 10 that most companies analyzed (38) have adopted practices aimed at greater sustainability.

In the last part of my research, I will confront the three interviews in order to understand similarities and differences.

All three companies interviewed are historical and base their core business on the quality of the raw materials used, in fact, all three have internal production. This suggests that food safety is respected and guaranteed.

All three companies operate in the b2b sector and wish to broaden the target audience to reach the end user (b2c). To do this, the companies rely on the influence that social media, SEM strategies, and e-mail marketing can have and the positive results they can bring. This is evidenced by companies themselves noting how digital marketing campaigns achieve the expected results. In particular, one company reports a case of failure of an offline marketing strategy aimed at acquiring new customers with a sales objective. This campaign generated zero sales. It is very likely that the same investment in a digital marketing campaign, properly targeted thanks to the big data, would have achieved a greater response. However, all three companies do not have a propensity to land on new platforms and this can cause problems in the future if the dynamic world of social media changes.

Digital activities are managed both internally and externally. In all three cases, there is no total management of the marketing functions. This can be seen as a consequence of the fact that digital marketing activities required specialization and in many cases is easier to find this knowledge externally than train someone internally. This can be also related to a recent digitalization that inevitably sees these figures as new.

Another interesting result is about e-commerce, in the three cases the results are positive, and sales increased particularly during the pandemic.

The three companies have invested in smart technologies and projects related to sustainability in recent years. This is because smart technologies allow greater efficiency and in fact, all respondents agreed on the benefits brought and there is an interest in continuing digitizing the company in the near future. Regarding sustainability, especially the environmental one, is taken into consideration in different measures but in any case, considered important. Projects such as photovoltaic systems and the reuse of resources and waste, result in a lower environmental impact and, at the same time, a reduction in costs.

A variable and uncertain data is given by the influence that the aspect of sustainability has on the people. It is needed more research to understand more about it.

Conclusions

The Agri-food sector is facing several issues and it is going to face even more if no action is taken. We have seen how events of recent years impact the compartment, for better or worse. In detail, two events particularly shook the industry, namely Covid-19 and the war in Ukraine, with different results.

In general, both situations have been and are an incentive to bring innovation to the sector by trying to solve problems related to food safety, provenance, traceability, and sustainability of the entire sector.

This thesis aimed to discover how digitization and sustainability in agri-food marketing can bring efficiency and competitive advantage and how consumer behavior is moving toward a more environmentally friendly outlook. Smart technologies and digital marketing are the key points of the digital transition. While, as far as sustainability is concerned, environmental sustainability is definitely the most felt.

As a consequence of the worsening economic performance after 2020 of the 14 companies that responded to the survey, digitization seen as digital activities and smart technologies is confirmed as the most effective response to this issue. This can be confirmed from the experiences of the three companies that responded to the in-depth interview. E-commerce is definitely the channel that gives the most satisfaction, followed by SEM strategies, which many times are used to sponsor the e-commerce itself, social media marketing, and finally, newsletters used to awaken inactive customers.

Digital marketing influences buying as much as classic television did, and continues to do, but in different ways and at different times. Today, with the flow of data, new technologies, and a super-fast information exchange network, all seasoned with ever-evolving algorithms, we are constantly bombarded with messages and advertisements that are increasingly targeted, personalized, packaged specifically for each of us, and ubiquitous on whatever platform we use. In an increasingly rapid, fragmented, constant, varied way. And if these inputs that we are all subjected to on a daily basis are matched with the right message that the company wants to convey, the likelihood that the purchase can be influenced is clear and tangible. Even in terms of brand equity and awareness,

nowadays it is fundamental to have a strong presence online, but as it is possible to see from the data desk, companies working in the B2B market see less utility in digital activities. This approach is incorrect and is highlighted by the companies interviewed as all three operate mainly in the B2B market and see online communication and digital presence as a great opportunity to further expand their customers' network. On the other hand, none of the companies taken into consideration have adapted, for instance, to the phenomenon of the moment, Tik Tok. This gives pause as it is a platform that is registering interesting numbers and the non-presence of companies shows that there is not a strong spirit of proactivity. The reason for the absence is mainly related to the difficulty in finding the right communication strategy.

From the interview results, automation of machines, the interconnection between them, and access to cloud-based servers enable greater efficiency than traditional systems by making operational processes much more streamlined.

Talking about sustainability, it is understood how this is a controversial issue as mentioned in the introduction of the thesis. It is not clear whether customers really pay attention to sustainability. It seems that most do, especially young generations, but this aspect requires further investigation. On the other hand, from the perspective of companies, sustainability, especially environmental sustainability, is a relevant aspect, both in order to adapt to trends and because, as shown in particular by one company interviewed, it allows for the reduction of costs thanks to smart technologies.

Since the agri-food sector is responsible for circa one-third of greenhouse gas emissions and all the problems that come with it, it is our job to change course. Change must be there throughout the supply chain, from producer to end consumer. As we have seen, thanks to new technologies, a more sustainable approach is possible, just as it is possible for the consumer to change habits by adopting more ethical approaches. Companies should be more proactive and take advantage of the opportunities given by innovation, but it is also true that especially smaller companies often experience financial difficulties in investing in the digital transition. This problem could be mitigated by the help of institutions with structured plans for national digitization.

Coming to the end of the thesis, it is necessary to point out that the analysis carried out is based on a limited number of companies under study. In any case, the research conducted

has achieved the goal of demonstrating how smart technologies and digital marketing strategies are a winning combination to cope with most of the challenges that the agri-food sector is facing and, therefore, to be competitive in today's market. Empirical studies about digitization and sustainability in agri-food marketing are still limited. Hence with this thesis, I would like to give my support to the research and incentive to research more.

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Bibliography

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