THE PARADOX OF AGRIFOOD

THE IDEAS TO MAKE THE GREEN AGENDA POPULAR AGAIN FOR THE MOST CLIMATE BASED INDUSTRY OF ALL[1]

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It was the protest of farmers in Amsterdam, Brussels, Berlin and Rome, which signalled that climate change (and "climate change fatigue"[2]) will be one of the few, EU wide policies at the centre of the next EU elections. And yet it is, again, the farming industry which is literally the most physically exposed to climate change.

It is this paradox that Vision is exploring within this paper, and it will become one of the most important inputs to the next VISION Dolomite Conference on global governance of climate change that will take place in October 2025 in Venice, immediately before COP 30.

The relationship between AGRIFOOD (we will group into this umbrella term both the strictly speaking primary sector – agriculture; as well as its transformation – agroindustry; and its distribution channels[3]) and climate change, is a crucial yet not enough accounted for factor. It is relatively a less investigated lever of climate change policies. Thus a crucial issue in what has been defined as the most critical battle in the history of an entire generation, underscoring the urgency of the issue.

Despite being one of the industrial sectors contributing the most to climate change, agriculture (particularly in meat production) is also the sector most impacted by rapid temperature changes. It is farmers, who bear the brunt of extreme weather, that have questioned more loudly than any other professional categories, the fairness of climate change policies, potentially derailing them.

This position paper is structured into two sections. The first – the problem setting - assesses the impact of climate change on different types of food and their contribution to climate change. The second section – the problem-solving - identifies potential solutions such as policies, technologies, and business practices and assesses their complexity and effectiveness.

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[2] As for recent Vision's column on The Guardian at https://www.theguardian.com/commentisfree/2023/nov/08/climate-fatigue-europe-voters-green-costs

[3] Which are both bricks and mortars and ecommerce

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1. THE PROBLEM SETTING – THE PARADOXES OF THE AGRIFOOD

The problem setting is defined by six dimensions that will define the strategic paradoxes that the agrifood industry needs to solve:

- the big impact that agrifood (with huge differences between different kind of food) is having on climate change;
- the huge damage that, on the contrary, food productions suffer because of climate change;
- the importance that consumers give to sustainability when they buy food (sustainability is much more important when we purchase food than when we but anything else, including clothes and cars);
- the bizarre nature of the relationship between food production and the EU (food is the sector which is most aided by the EU and yet farmers are amongst the most Euro sceptical segment of voters);
- the co-existence at global level of both problems of scarcity (hunger) and abundance (obesity) of food which are all problems to be turn into opportunities.

1.1 - THE MEATY PROBLEM – THE IMPACT OF AGRIFOOD ON CLIMATE CHANGE

Ruminants account for 94% of non-human mammal biomass (including whales and sharks); livestock outweighs wild mammals by a factor of 15-to-1. There are approximately 1 billion living cows, and they overall weigh as much as all humans put together (although one third of them are slaughtered yearly. to be more than replaced the year after). On the other hand, poultry accounts for 71% of bird biomass, surpassing wild birds by more than 3-to-1.

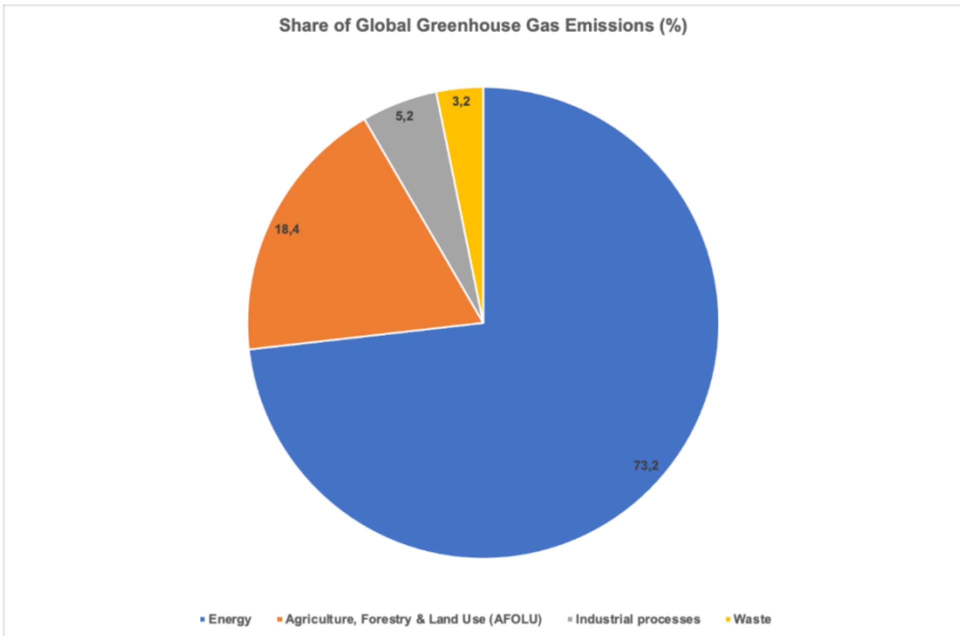
These numbers are enough to indicate the magnitude of how the industrialization of the oldest human organized activity has changed natural equilibria that lasted for thousands of years. And since quantity matters, the industrialization of agrifood has got huge externalities.

AGRIFOOD is one of the industries (probably the second after fossil energy production) contributing the most to the 40 billion tonnes measured in carbon dioxide equivalents (CO2) that impacts the most on climate change.

As for the following chart, an overall map of the distribution of GHG (greenhouse gases, which is a notion larger than CO2 emissions, also includes methane and other pollutants) says that:

1. nearly three-quarters of emissions stem from use of energy;
2. approximately one-fifth stems from agriculture and land use (expanding to one-quarter when factoring in the energy consumed by the processing of food plus packaging, transport, and retail);
3. the remaining 8% from industrial transformation (beyond the energy consumed, and thus generated mainly by chemicals and cement) and (water and solid) waste;
4. 15% of the GHG produced by agrifood/ agriindustry business is from transportation;
5. the packaging of food contributes to 0.94kg of CO2 for every kilogram of food.

GRAPH 1.1.1 – DISTRIBUTION OF GHG EMISSIONS



SOURCE: OXFORD MARTIN SCHOOL – OUR WORLD IN DATA[4]

Thus, the share of emissions produced by the food industry appears to be more than a quarter of the total. This indicates that industry weighs disproportionally on climate change when we consider that it accounts for 4.3 % of the global economic output (the GDP).

Additionally, half of the world's habitable land is utilised for agriculture, and 70% of international freshwater withdrawals are dedicated to agricultural activities. Agriculture is also responsible for 78% of global ocean and freshwater eutrophication,[5] which is characterised by the pollution of waterways with nutrient-rich water.

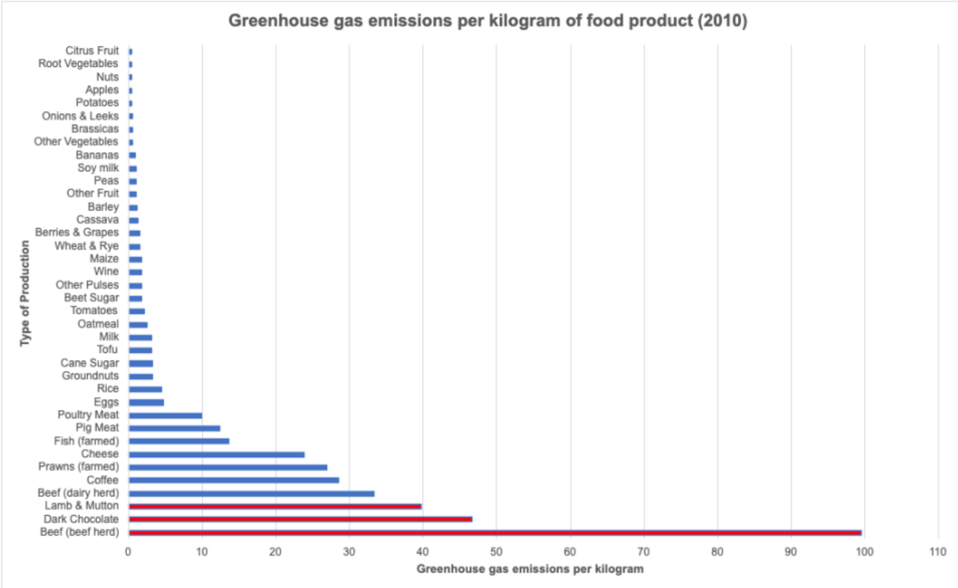
We can argue that the old primary sector (it historically came before manufacturing and services) is one of the most contributing factors to climate change (it is probably second only the oil industry and chemicals). Paradoxically it regained the political relevance it seemed to have lost, just because of the policies meant to address this.

The next question that the “problem setting” must consider is about differentiating such footprints by different typologies of “food.” The chart below gives a preliminary assessment:

[4] Ritchie, H. (2020). “Sector by sector: where do global greenhouse gas emissions come from?” Published online at OurWorldInData.org. Retrieved from: 'https://ourworldindata.org/ghg-emissions-by-sector' [Online Resource]

[5] It denotes a condition of nutrient richness in a given environment, particularly an abundance of nitrates and phosphates in an aquatic environment.

GRAPH 1.1.2 – GHG EMISSIONS PER KILOGRAM OF FOOD PRODUCED



SOURCE: OXFORD MARTIN SCHOOL – OUR WORLD IN DATA[6]

The evidence confirms that meat has a much bigger footprint than fruit or vegetables, with fish and dairy in between.

In addition to the impact of different food on climate, we, however, also need to consider that, as much debated, other diets (and thus a diverse mix of proteins, vitamins, carbohydrates and fibres) have profoundly different implications on the health of people. In a dramatic sense, meat damages humans because it does not only contribute to severely altering the climate, but because it is a factor of cancer and cardiovascular diseases (according to the WHO guidelines). We will come back to this in section 1.5.

We will now explore the second leg of our analysis: to what extent does climate change damage different productions of food (and the income of farmers)?

1.2 THE FIRST CASUALTY OF GLOBAL WARMING – IMPACT OF CLIMATE CHANGE ON AGRIFOOD

Minas Gerais (Brazil) and Trentino (Italy) are ten thousand kilometres apart. And yet in both, farmers are already fighting a battle for survival against climate change. In both warming is an existential an ongoing battle with climate change to save some of their most valuable economic assets.

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[6] Ritchie, H. (2020). "Sector by sector: where do global greenhouse gas emissions come from?" Published online at OurWorldInData.org. Retrieved from: 'https://ourworldindata.org/ghg-emissions-by-sector' [Online Resource]

In Brazil, farmers always look for higher locations to cultivate coffee (specifically the "arabica" type), which can only tolerate temperatures within a specific range. The same thing happens near Trento for the producers of local "spumante" (the rival of the French "champagne") that is being frequently relocated towards more hilly, less easy terrains. The cost of climate change is something that both Brazilian and Italian farmers are experiencing in their daily lives.

The argument that the primary sector is the industry most heavily impacted by climate change is, after all, intuitive. Farming happens literally under the sun: in connection (some would say "in harmony") with land and thus with what happens in the atmosphere.

It is, indeed, not the case that farmers are traditionally the segment of the population most interested in weather forecasts and that an essential component of "precision farming" technologies is about linking cultivation choices to precise, very localised forecasts; if we try to categorise the consequences of climate change, we will find that not only:

1) mere rising temperatures, but also
2) erratic precipitation patterns exist, and
3) more frequent and intense extreme weather events (floods, drought, hurricanes) occur.

They are all disrupting traditional farming practices and making them economically unsustainable.

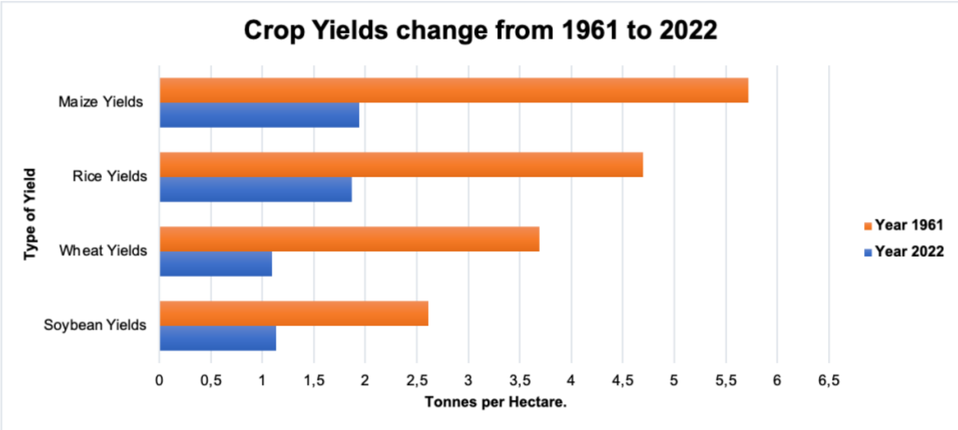
Farmers have long relied on established seasonal patterns and must predict the planting and harvesting cycles. This unpredictability is further compounded by the spectre of water scarcity, an escalating challenge exacerbated by climate change that endangers irrigation systems and magnifies the susceptibility of agricultural regions to crop failures.

According to some estimates, global yields could decline by up to 30% by 2050 without effective adaptation. The economic impact of climate, as measured by the average marginal effects, indicates a significant correlation between temperature fluctuations and export values.

The impact of temperature isn't uniforms across all countries. In a colder country, like Russia, warmers temperatures can actually be beneficial. This might extend the growing season and productivity. On the other hand, there are some regions, like Puglia, Italy where higher temperatures can exacerbate existing problems like water scarcity and heat stress on crops. This can lead to decrease productivity. These contrasting outcomes illustrate the different potential of climate changes on agriculture and trade. While some region may see benefits from warmer temperature, others may suffer losses and economic issues.

This nuanced perspective is crucial for policymakers and businesses, underscoring the importance of region-specific strategies to either capitalize on or mitigate the effects of climate change. Tailored approaches could range from adapting crop varieties to suit changing climates, investing in water-efficient technologies in vulnerable regions, or exploring new markets for regions newly suitable for certain crops. The following chart provides a preliminary assessment of how varying cultivations might respond to increasing temperatures, offering a visual representation of these complex dynamics. By understanding these diverse impacts, stakeholders can better navigate the challenges and opportunities presented by climate change, ensuring economic resilience and sustainable growth in the face of environmental shifts.

GRAPH 1.2.1 – CHANGE IN CROP YIELDS FROM 1961 TO 2022



SOURCE: OXFORD MARTIN SCHOOL – OUR WORLD IN DATA[7]

Over the last 30 years, an estimated €3.6 trillion worth of crops and livestock production has been lost due to natural disaster events, corresponding to an average loss of €117 billion per year or 5% of annual global agricultural gross domestic product (GDP), according to a new report released recently by the Food and Agriculture Organization of the United Nations (FAO)[8].

The vulnerability of agrifood systems to climate change poses a significant threat with far-reaching consequences. As temperatures rise and weather patterns become more unpredictable, the delicate balance required for optimal growth in agrifood production is disrupted. Extreme weather events, including droughts; floods; and heatwaves, jeopardise crop yields and the entire food supply chain. These events' increasing frequency and intensity undermine food security, lead to economic losses for farmers, and threaten global food production. Moreover, shifts in temperature and precipitation patterns may favour the proliferation of pests and diseases, further compromising the health of agrifood systems. The interconnectedness of these factors amplifies the potential for widespread food shortages, escalating prices, and socioeconomic instability. It is crucial to recognise that crops are the most vulnerable component of the agrifood business, necessitating urgent attention and proactive measures to build resilience within this critical sector.

The problem setting then points to reframing the relationship between agrifood and climate change. Not all sectors contribute equally to climate change; not all are similarly impacted. Industrialised meat production is more heavily contributing and less damaging than the cultivation of wine or maise (which is fundamental for the survival of millions of people). Moreover, the mix of different food production differs a lot amongst countries, with, for

[7] Ritchie, H., Rosado, P. and Roser, M. (2022). "Crop Yields". Published online at OurWorldInData.org. Retrieved from: 'https://ourworldindata.org/crop-yields' [Online Resource]

[8] https://sendaiframework-mtr.undrr.org/publication/report-midterm-review-implementation-sendai-framework-disaster-risk-reduction-2015-2030

instance, the USA strongly relying on industrial livestock and countries like Ukraine or Vietnam depending on crops.

1.3 - CONSUMERS CHOICES AND SUSTAINABILITY: (ALMOST AS) IMPORTANT AS TASTE

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1.4 - THE “HATE AND (NOT MUCH) LOVE” AFFAIRE BETWEEN EUROPE AND FARMERS

"In this room there is no one whose family tree doesn't reach back, sooner or later, to farming roots", with these words, the first President of the European Commission, Hallstein from Germany, presented the first budget of what was then called the European Economic Community (EEC), dedicating 75% of its resources to agriculture. Seventy years later, Europe is returning to the land because there is no other productive sector that will have a more direct influence on the next election of the European Parliament. We are facing one of the most critical battles in the history of all generations. Both the past and the future of the Union seem tied to food, which is why it is in the interest of all political parties to better understand the triple paradox in which farmers and large food processing industries are trapped.

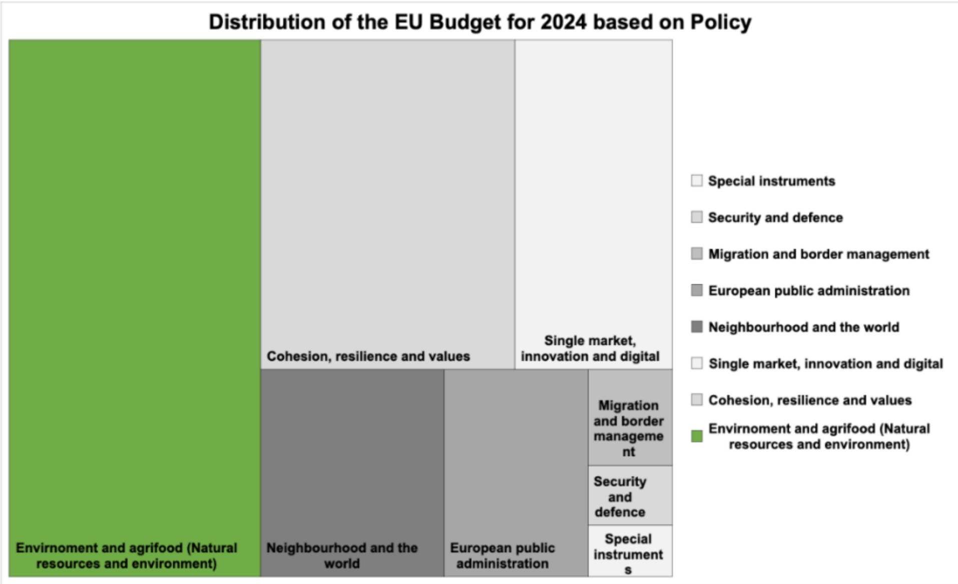
Less than 5% of European workers are engaged in agriculture, living with a triple contradiction that makes them politically significant. Firstly, agriculture manages to be both the sector that (after energy) contributes the most to climate change and is simultaneously the one that suffers the most devastating consequences. It is worth noting that the progressive increase in awareness of the importance of food culture has been paralleled by a growing impact that this sector has had on climate change. However, this data varies by production: meat production generates more emissions than the entire chemical and petrochemical industry, while oil and rice are at high risk.

Secondly, agriculture is still the industry to which the European Union dedicates the most resources (€60 million annually) and yet, it has also sparked the harshest protests.

Finally, there is no doubt that food is the distinctive value that everyone recognizes in Europe, yet this struggle fails to translate into added value. For example, Italy continues to export less than it imports. The tractor protests reaching Brussels are proving to be one of the few factors capable of truly shifting votes and changing European priorities. Giorgia Meloni, the Italian Prime Minister who added the mandate of "food sovereignty" to the Ministry led by Francesco Lollobrigida, immediately understood the need to increase efforts to protect farmers from uncontrollable changes. However, can we imagine a reform of the Common Agricultural Policy (CAP) radical enough to move from "defending" a sector that needs support, to a strategy that transforms it into an industry capable of triggering major innovation processes? There are three ideas to further develop.

Firstly, we must abandon the logic that has accompanied the CAP for seventy years of permanent subsidy. This subsidy, strangely enough, is linked to the quantity (hectares) of cultivated land. It's a mindset that assumes the inevitability of decline and doesn't reward those who - through intelligent use of technologies or better organization - increase production per hectare or the value they extract from that production. Over time, subsidy payments have been conditioned by a series of controls, not always shared, which have had the damaging effect of increasing bureaucracy that ultimately harms those with less time. However, the idea of "income guarantee" (as explicitly provided by the largest of the two CAP "funds") discourages (just like the Italian "citizens' income") those who want to try be independent of state support. One hypothesis could be to help those who have achieved less success and want to do more.

GRAPH 1.4.1 – EU ANNUAL BUDGET DISTRIBUTION BY CATEGORIES (2021 – 2027, BILLIONS OF EURO)



SOURCE: EU COMMISSION[9]

Secondly, we must abandon the romantic but harmful idea of protecting small family businesses, there exist mechanisms for redistribution that keep the small ones alive. Instead, it must be admitted that agriculture is an industry. Like all others, it needs economies of scale and specialists who, within the company, specialize in finding new technologies or markets. An alternative to the large companies that dominate international markets (such as the American or Brazilian ones) has been cooperatives, which have even managed to organize sophisticated distribution channels.

Thirdly, we must strengthen the second pillar of the CAP, the fund for rural development, and this fund must host territorial strategies aimed at making entire territories both more competitive and less environmentally impactful. Currently, the logic of the "green deal" that Europe has imposed on itself imposes a series of prohibitions and requests for land not to be cultivated on farmers: it is wrong for these measures to be the same for everyone, in a continent ranging from the lands of Santa Claus to those hot lands bordering Morocco. Much more respectful of the intelligence of businesses, which should be treated as such, can instead be the setting of a few clear objectives that are compatible with the economic and environmental sustainability of the sector. A few "targets" should be defined with businesses and institutions in a certain area (the Italian provinces were perhaps the right size) on which to depend (just like for the National Recovery and Resilience Plan) the provision of funds that accompany the ambitious transformation that Europe must undertake as its mission.

[9] European Commission, Directorate-General for Budget, (2021). *The EU's 2021-2027 long-term budget and NextGenerationEU : facts and figures*, Publications Office of the European Union. https://data.europa.eu/doi/10.2761/808559

Agriculture has so far been the most faithful mirror of a trait that has defined Europe: an endless negotiation to pull on one side - the large industrial enterprises like Germany and Northern Europe - or on the other - France with Italy and Spain - a blanket too short. We have been in a century for some time now that asks us to abandon stereotypes long dead and realize that in agriculture (as well as in tourism), there are opportunities to conquer leadership in a century that began twenty-four years ago.

1.5 - THE EVOLUTION OF THE IMPACT OF AGRI-FOOD ON HEALTH

We all know that "we are what we eat[10]." Yet this becomes even truer with the increasing personalisation of diets and food needs.

.. to be developed..

1.6 - FOOD AS EU'S COMPETITIVE ADVANTAGE AND IDENTITY FACTOR

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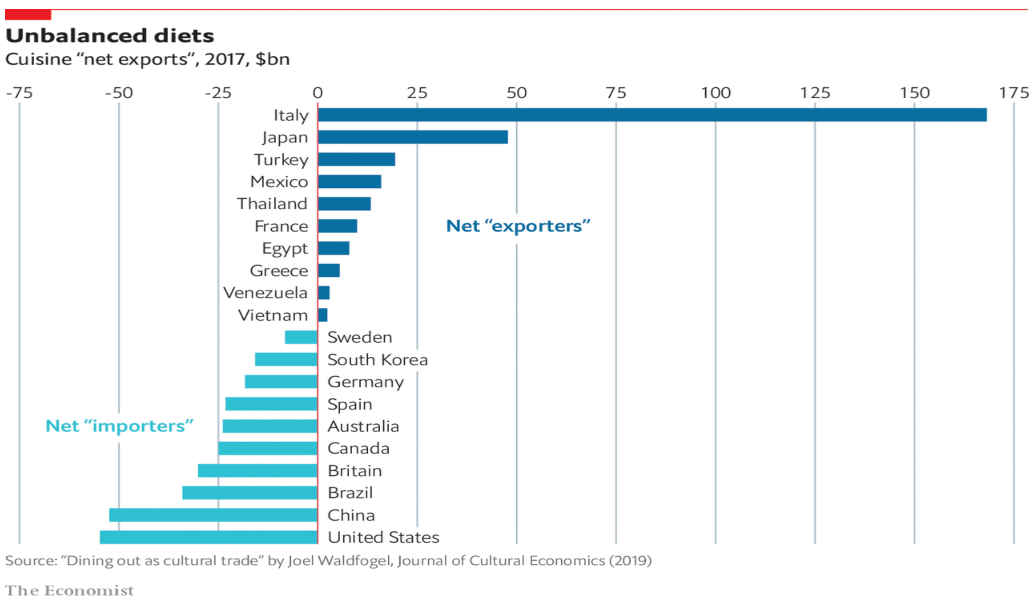
1.7 - ITALY AS A FOOD SUPERPOWER: A NEVER ENDING STORY OF (ALMOST ALWAYS) MISSED OPPORTUNITIES

.. to be developed..



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[10] Vasundhara Sawhney, August 2021, Harvard Business Review

2. THE PROBLEM-SOLVING: TECHNOLOGIES, CORPORATE, MARKETS, POLICIES

Based on the problem setting, we are proposing seven ideas that an interaction with the communities of farmers, agro-industries and policy makers may transform into a possible proposal.

2.1 - BETTER ORGANISATION, MORE ECONOMIES OF SCALE

2.2 - TECHNOLOGIES FOR REDUCING FOOTPRINT AND INCREASING ECONOMIC SUSTAINABILITY

Sustainability in agrifood systems is a complex multidimensional concept, encompassing a wide array of dimensions and challenges to tackle. While reducing the environmental footprint is essential to preserve the capacity of ecosystems to produce adequate and safe food for the globally increasing population, it is equally important to emphasize the relevance of social and economic sustainability. Besides the reduction of the environmental footprint of agrifood production, it is crucial to guarantee adequate remuneration to farmers, enhance their power along the food supply-chain, and ensure safe and satisfactory working conditions. Consequently, to address these challenges, it is necessary to adopt a multidisciplinary approach, which aggregates various and strongly interconnected solutions.

The challenge of achieving a more sustainable agrifood production requires integration and synergies between sectors, technologies and a combination of social, economic and environmental issues. This is a process that involves technical, governance and financial dimensions, hence there is not a single solution but rather multiple pathways (FAO, 2017). Nonetheless, there is a wide consensus about the relevant role of technology – and particularly, digital technologies - in increasing the sustainability of agrifood systems.

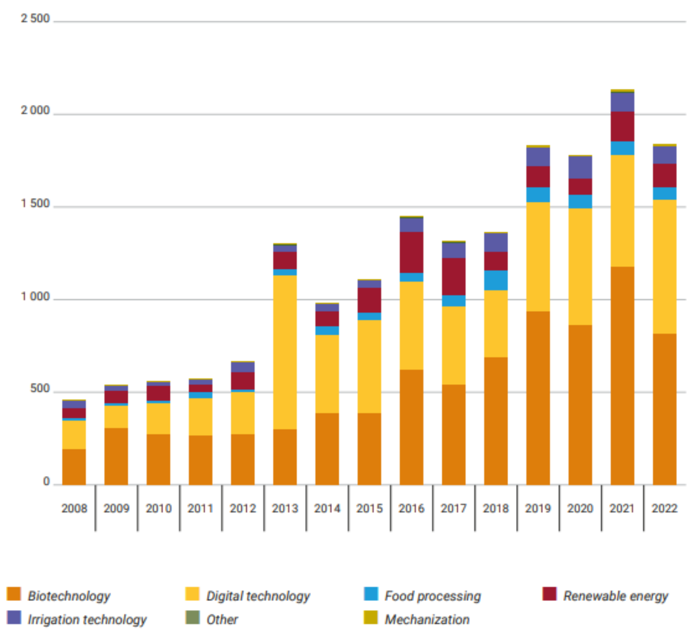
A fundamental level of response is innovation, which can (and must) act at multiple levels of the problem and along the entire agrifood supply chain, from the field to consumption. Several types of "innovation" exist (in technologies, processes, business models, supply chain configurations and agreements, cross-sectoral collaborations, policies), but the pivotal role of technological innovation is undeniable. Technologies commonly applied in the agrifood sector can be divided in several groups, for example FAO (2023) proposes a classification into six categories:

- Digital technologies: these can boost agricultural productivity, help adapt to climate change, improve animal welfare, optimize resource use, and enhance rural resilience. They can also integrate small-scale producers into markets (e.g., allowing them to reach consumers via eCommerce) and improve the efficiency of policy design and implementation.
- Biotechnologies: ranging from low-tech methods like artificial insemination to high-tech DNA-based approaches, biotechnologies help develop stress-resistant crops, improve food nutrition and longevity, ensure food safety, monitor biodiversity, enhance soil and animal health, and support rapid disease diagnosis and vaccine development.
- Mechanization: it includes technologies for farming and raw material processing, ranging from manual tools to advanced motorized machinery. Sustainable agricultural mechanization can

reduce labor fatigue, address workforce shortages, create jobs, improve productivity, lower harvesting costs, enhance resource efficiency and improve market access.

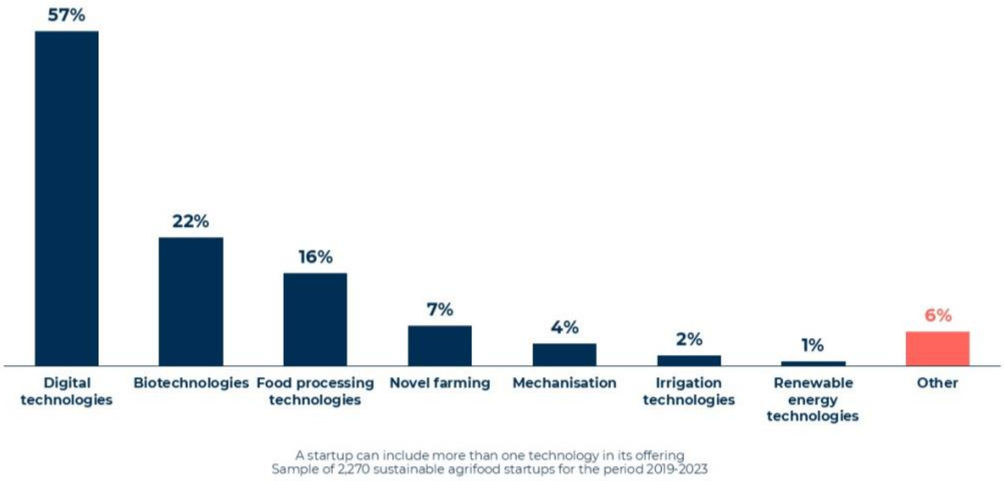
- Irrigation technologies: these involve techniques, skills, and methods used to artificially apply water to support crop growth either through surface irrigation (letting water flow over the land), sprinkler irrigation (spraying water under pressure) or localized irrigation (delivering water directly to the plant).
- Renewable energy technologies: these harness sources like wind, ocean, solar, water, geothermal, and biomass to generate energy. Sustainable energy-focused agrifood systems not only conserve energy, but can also produce it, capitalizing on the close relationship between energy and food.
- Food production technologies: these involve methods and equipment used to process agricultural products (like grains, meat, vegetables, fruits and milk) into food ingredients or processed food products.

Over the past 15 years, there has been a steady rise in the application of these technologies within the agrifood sector, as shown in the figure below (FAO, 2023), that reports the distribution of technologies in the agrifood sector over time in more than 40,000 analysed documents. It is possible to observe that the most important technologies applied in the agrifood sector are biotechnologies and digital technologies.



Annual distribution of documents by technology type. Each document was classified with one technology category. Source: FAO, 2023

Differently from other types of technologies, that are often specific for a certain stage of the food supply-chain, digital technologies and solutions are pervasive along the overall food supply-chain, improving in each stage the sustainability of food production and consumption. For example, if we consider startups operating in the agrifood chain focusing on the sustainability of the agrifood sector, on a sample of 2270 startups the 57% offers on the market solutions enabled by digital technologies, whereas the 22% by biotechnologies and the 16% by other technologies for food processing (Food Sustainability Observatory, 2024)

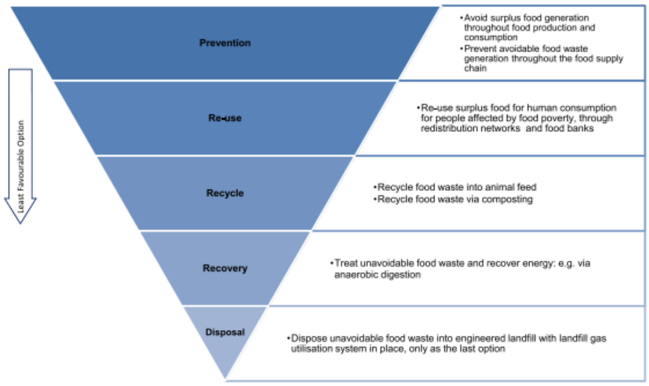


Technologies enabling sustainable startups in the agrifood sector. Source: Food Sustainability Observatory, 2024

In the agricultural phase, Communication technologies, Internet of Things (IoT), Data analytics and Big Data, Artificial Intelligence (AI) and Machine Learning, Cloud Computing, Geographic Information System (GIS), Image Processing, Drones and UAVs, Blockchain etc., are generally recognized as technologies that enable a wide range of solutions that in turn are transforming the global agriculture, increasing productivity while reducing the impact on natural resources and alleviating the intense work of farmers. This is mainly due to the ability of these technologies of capturing, analysing and sharing data, providing farmers with valuable pieces of information that can improve decision-making and practices' implementation, with clear benefits on efficiency, productivity and sustainability. Considering the principles of the Triple Bottom Line (TBL) - evaluating the sustainability performances according to three different lenses: people, planet and profits (Hacking & Guthrie, 2008) – digital technologies can have positive impacts on economic, social and environmental sustainability. For example:

- Planet: the reduction of production inputs can lead to a decrease in the environmental impacts linked to highly polluting inputs such as agrochemicals, an increase in the efficiency of water use, and an enhancement of biodiversity. Animal welfare can also benefit from digital tools (such as sensors to promptly detect animal illnesses, cameras and data management platforms to analyse animal behaviours, etc.)
- People: technologies can help in reducing time and efforts while carrying out operations, or in making the certifications and administrative processes more efficient (for example: web platforms dedicated to data sharing among farmers, Public Administrations and certification bodies), resulting in the alleviation of physical and intellectual work for farmers (Smart AgriFood Observatory, 2020). Additionally, the use of digital solutions can help sustain products and territories – by promoting sustainable local growth - and preserving food quality and safety.
- Profit: digital solutions can lead to an increase in productivity and cost reduction. The former refers mainly to process efficiency while the latter is related to input use reduction (agrochemicals, water, etc). Additionally, enhancement of farm productivity and increase in food quality can lead to a growth in profits.

Technological innovations play a fundamental role also when it comes to food loss and waste prevention and reduction. Considering the "Food Waste Hierarchy" as a framework for food loss and waste management, digital solutions intervene particularly in the first and second step (namely "Prevention" and "Re-use for human consumption").



The food waste hierarchy. Source: Papargyropoulou et al. (2014)

Solutions which shorten supply chains (often through the use of online platforms to connect producers and consumers), platforms to align supply and demand (for example through the improvement of demand forecasts thanks to the collection and the elaboration of data based on Artificial Intelligence technologies), solutions to improve the management of stocks in the warehouse (for example through software for the implementation of dynamic pricing strategies based on the residual life of the products, leveraging IoT and AI technologies) are among those used to prevent the generation of surpluses. Furthermore, digital tools for monitoring the temperature and other critical parameters along the supply chain, allowing to monitor the state of conservation of the product are very important to avoid the early organic decay of fresh products. This is the case, for example, of IoT solutions ("as "beacon"), that can monitor in real-time the temperature during storage and transportation of perishable products and to launch immediate alert in case of a cold chain. Once the surplus has been generated, examples of digital solutions in the "re-use for human consumption phase" are eCommerce platforms that can be used to sell the surplus food at a lower price. Digital platforms can also be very useful to support and make the redistribution operations of surplus food to people in need from charitable organizations (such as the Food Banks) more effective.

In the effort to reduce the impact of agrifood chains and increase their sustainability, it is fundamental to adopt effective measuring systems: for this reason, attention is growing for the measurement and reporting of sustainability performances along the supply chain and for the implementation of digital solutions that can improve data collection, analysis and reporting. These tools are particularly focused on environmental aspects (e.g. carbon and water footprint, the use of natural resources and the impact on biodiversity) but there is a growing interest in the measurement of social and economic dimensions. Those tools work mainly on the data analysis phase: they are software, working with data (and Big Data) analytics and increasingly leveraged by innovative technologies such as Artificial Intelligence. A minor – but interesting - number of solutions is devoted to collecting data: the use of technologies such as Mobile and Internet of Things can help in making this phase more effective and in reducing errors thanks to the automatization of data collection.

Finally, also consumers' dietary choices have an important impact on the reduction of the agrifood chain impact. Digital solutions can help in promoting more sustainable consumptions in different ways: from enabling "short supply-chains" (mobile app and platforms connecting farmers and consumers), to platforms where it is possible to buy surplus food, to enabling the education of consumers for a more sustainable way of eating.

Considering the wide consensus about the positive impacts of innovation on the sustainability of the food sector – supported by research and numbers - those technological solutions should be more widely adopted and integrated in existing processes and production systems. Positive signals arrive from the market: just to make an example: the global market of Agriculture 4.0 solutions is expected to grow of 10.4% by 2029 (Markets and Markets, 2024), and in Italy has grown at an average rate of 24% in the last 3 years (2020-2023) (Osservatorio Smart AgriFood, 2023): a growth driven by the needs of farmers to reduce the use of water, technical inputs and to make the work more sustainable. Despite this, barriers to the adoption of innovations in the agrifood sector still exist: economic and financial, infrastructural and skills and knowledge related. Particularly, there is the need to generate more awareness about the benefits to overcome the economic and financial barriers and to increase digital skills, to make digital adoption inclusive and beneficial for all the actors in the agrifood chain.

2.3 - FROM BANS TO INFORMATION: HOW TO EMPOWER CONSUMERS AS LEVEL OF TRANSFORMATIVE SUSTAINABILITY

The idea here is to empower consumers to access information and choose quickly. The thesis is that they will make better choices if they are aware of a particular fossil's footprint or its impact on health.

Consumers hold considerable power to influence the environmental footprint of the food they consume through their choices. If consumers understand how harmful the impact of their food consumption on the environment is and on their own health; this could really be one of the key points to reduce the impact of agri-food on the environment.

We wield significant influence as individuals and integral components of the human collective. Through the conscientious choices we enact daily, we can affect meaningful change in the world.

Indeed, it is not useful to ban certain crops, such as meat, but instead to require producers to give information about the production of their products, giving the chance to consumers to decide what to buy.

Information campaigns are crucial for this effort, supported by trustworthy research and data and clear labels and certification. Implementing QR codes on food packaging to inform consumers about products' environmental impact is a commendable initiative. By scanning the QR code with their smartphones, consumers access a comprehensive dataset including various aspects of the product’s production, such as carbon footprint; water usage; pesticide and fertilizer application; and packaging materials. This data, derived from rigorous scientific research, could be presented as user-friendly, facilitating informed decision-making.

However, it is also true that not every consumer may have the time to review all this information about one single product. To address this issue, an alternative approach is aggregation: the development of a software that provide users with personalized recommendations and information about the environmental impact of different food products. This software could suggest, weekly for example, the best products to buy and the most sustainable brands based on specific parameters, such as dietary preferences;

location; sustainability priorities; and health considerations. An alert would still be sent to the consumer when a single decision is going beyond some sustainability threshold.

Supporting sustainable production practices is another crucial aspect of consumer empowerment. Consumers wield considerable power in driving demand for sustainable production practices. Research indicates that products with eco-certifications, such as Organic Fair Trade or Rainforest Alliance, are increasingly preferred by consumers conscious of environmental concerns. Data from the Organic Trade Association reveals that sales of organic food and non-food products in the United States reached $56.4 billion in 2020, reflecting a growing consumer preference for environmentally responsible products. By consciously selecting locally sourced, seasonal, and organic foods, consumers can actively contribute to reducing the carbon footprint associated with transportation and supporting farmers committed to environmental stewardship.

2.4 - AFRICA AND THE NEIGHBOURHOOD: TURNING FEARS INTO OPPORTUNITIES

2.5 - LESS BUREAUCRACY, MORE MILESTONES/TARGETS: A RADICAL REFORM OF EU'S CAP

2.6 - PLACE BASED RURAL STRATEGY: DIFFERENT MIX SO TO DECREASE FOOTPRINT AND INCREASE RESILIACE

2.7 LESS QUANTITY, MORE QUALITY: A POSSIBLE WAY OUT FOR MEAT PRODUCERS

3 THE PROBLEM OWNERS: THE ROLE OF PRIVATE SECTOR AND CORPORATE GOVERNANCE

Agrifood has been impacted by weather and climate change, worldwide, since ever: lack of water, extreme events and gradual changes of the environment have been forcing land and cattle owners to modify their practices. It is a resilient industry that has proven the ability to adapt and introduce innovations at all levels, often dealing with uncertainties in regulatory environment and policies delays. The extent and the speed of the required change are both becoming bigger and bigger, while the increase in world population is accelerating growth in food demand, creating a sense of urgency.

As discussed in paragraph 2, the solutions are available and needs to be assessed in a holistic way. What is clear is the need of a farsighted approach, which fully includes adaptation efforts (which are reactive) with a long-term mitigation strategy (more proactive). Public policies play a major role in setting goals and driving behaviors, ensuring a fair transition and transparent competitive environment. But private players – from large corporations to small entrepreneurs – need to take ownership in making the change. They need to revisit the way of doing business, with more planning ahead, more collaboration across the industry and the value chain and the development of an innovative strategy. Ultimately, it is about incorporating climate change into the elements that constitute decision making, that is good corporate governance: from risk assessment to setting climate targets and developing mitigation strategies, as well as enhancing transparency and accountability by reporting on environmental impact. In this context, CEOs lead the change while boards of directors play a crucial role in overseeing climate governance, including the adequate engagement with the key stakeholders of the agrifood companies and the finance community.

3.1 INTEGRATION OF CLIMATE IN CORPORATE PROCESSES: FROM RISK ASSESSMENT TO STRATEGY DEVELOPMENT

A comprehensive climate and environmental **risk assessment** is the starting point for building a path for solid decision-making. The Task Force on Climate-related Financial Disclosure (TCFD) published in 2017 a framework to assess and disclose climate change risks[11]. Even though the framework has now been embedded into the FSB activities, its recommendations remain the basis of good governance practices. TCFD introduced a taxonomy of climate risks, including physical risks and transition risks, and a thought process to build a strategy.

The first risks category – **physical risks** - includes chronic (impact of gradual changes on climate factors - such as higher temperatures, sea level rise, and water stress) and acute risks (impact of extreme events in a short timeframe such as heavy storms, floods and droughts). They are increasing dramatically in intensity and frequency to the point that historical data are not enough to build reliable forecasts. For agricultural players, it is critical to estimate how environmental changes may accelerate in the next years, possibly using scenarios. How fast and how deeply resources may be impacted (from water to land)? Assuming a longer forward-looking timeframe perspective brings new light to risk assessment and corporate decision-making. The availability of science data and tools for their interpretation, including Artificial Intelligence, helps to increase awareness of upcoming threats and to build adaptation strategies.

Similarly, **transition risks** may affect the business in multiple ways, especially since they drive long-term shifts in the value chain: new policies and regulations (example: restrictions on deforestation, fertilizers or packaging material), costs increase (example: energy prices and cost of transportation) or change in consumers preferences (example: quantity of annual consumption of cow products).

Understanding climate risks[12], their timeframe and their size, provides the degree of urgency that a specific business is facing. The measurement of a business impact has two aspects (**dual materiality**)[13]:

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[11] Publications | Task Force on Climate-Related Financial Disclosures (fsb-tcfd.org)
[12] Agriculture-Sector-Risks-Briefing.pdf (unepfi.org)
[13] EU Linee Guida (2019)

- "inside-out" (how many GHG emissions the business produces, i.e. from the enterprise to the environment) and
- "outside-in" (which financial impact is the business-facing due to climate: from the environment to the enterprise).

Both measurements may be complex to assess. The calculation of **GHG emissions** is meaningful if it includes the entire value chain: emission produced by suppliers and customers[14]. The estimation of financial impact may require scenario analysis and assumptions to properly include future trends.

Large corporations in the agrifood business are systematically applying analytics and frameworks to set their priorities and develop strategies.

Adaptation strategies are the result of responses to estimated physical risks, for example: introducing technology for smart irrigation to cope with water/rain scarcity, changing type of farming techniques to higher temperatures, using drones or data from satellite observations for precision agriculture or for selecting safe locations.

The real challenge for business leaders is to turn a set of adaptation initiatives into long-term **mitigation strategies**: the agrifood industry has an opportunity to accelerate the transition to a more sustainable business model, contributing to a positive impact on the decarbonization path. This may require unprecedent courage to change the way of working through the life cycle and ultimately to drive consumers' habits. Examples are: introducing energy efficiency solutions across production and distribution, fully leveraging circular economy, introduce technology solutions, develop more sustainable logistics, and develop new products with lower carbon footprint. More likely, these activities need to be taken all together. It would include a commitment towards efficiency measures, change in land utilization and contribution to carbon capture[15]

Climate transition does require large capital investments, with returns visible in the medium-long term. The **finance community** has a major role to play in providing capital for sustainable projects: it is one side potentially impacted by climate risks and on the other side able to growth offering new financing products to the industry. Rigor and vision are both essential for industry players to raise capital and grow profitably: they need to set mitigation strategies with credible targets in the medium to long period and a clear path to get to net zero by 2050.

3.3 THE ROLE OF THE BOARD: STRATEGY, DISCLOSURE AND ACCOUNTABILITY

The World Economic Forum in 2019 issued the Climate Governance Principles on "How to set up effective climate governance on corporate boards" based on the awareness that this major transformation can only happen with a strong support from the top: an educated and motivated board should lead management to have the right time horizon and be ambitious

[14] The GHG emissions, as per the GHG Protocol, include direct emissions (scope 1) and indirect emissions (scope 2 and scope 3) https://ghgprotocol.org/corporate-standard

[15] Pathways towards lower emissions (fao.org)

02-19-net-zero-agriculture-in-2050-how-to-get-there.pdf (europeanclimate.org) to set winning strategies. There are clearly tradeoffs to manage – short versus long term – and uncertainties to face – mainly on regulatory framework and political support. This is why climate change is the ultimate governance challenge.

If the WEF initiatives aim at promoting a greater business engagement on climate, regulatory authorities have put boundaries and obligations to ensure disclosure and drive behaviors: this increases the responsibility of business owners and boards and makes the transition plan not an option anylonger.

Europe has been at the forefront: since 2014 listed entities, banks and insurance companies have been required to disclose how they deal with climate-related risks and opportunities. Since January 1, 2024 the Corporate Sustainability Reporting Directive requires the same companies (gradually including also smaller entities), more specifically:

- to adopt plans (that include implementation / financial/ investment plans) to ensure coherence of their business with the transition to a sustainable economy and with the 1.5° limit under the Paris Agreement and the European climate neutrality target by 2050 and the 2030 climate target (so called fit for 55%);
- to fix greenhouse gas reduction targets for, at least, 2030 and 2050 and progression on them (making reference to conclusive scientific evidence and expressed in absolute value, i.e. gross targets);
- to show climate change mitigation (including reference to Scope 1, 2, 3) <u>and</u> adaptation projects;
- to explain how they consider water and marine resources, how they deal with circular economy, pollution, biodiversity and ecosystems.

The agrifood industry will be impacted directly (for its own obligations) and indirectly (for the requirement of their customers and financing institutions). Notably a growing number of Central Banks (starting from ECB) are taking steps to address biodiversity loss as a systemic risk to be managed in order to preserve ecosystems, as addressed by NGFS (the Network for Greening the Financial System, which includes more 100 central banks and supervisory authorities). The interest from the financial sector on climate and biodiversity will bring to the agrifood sector more scrutiny but also more resources for the transition plan.

3.2 ENGAGING AGRIFOOD STAKEHOLDERS ON CLIMATE CHANGE ISSUES

Stakeholder engagement is crucial for an effective climate change strategy: it builds consensus, increases buy-in, and ensures the relevance and feasibility of climate change initiatives. It can face challenges such as conflicting interests, limited resources, and lack of awareness. However, it also presents opportunities for collaboration, innovation, and knowledge sharing among diverse stakeholders.

Identify key climate change stakeholders is prior to any effective action: key stakeholders include farmers, suppliers, distributors, retailers, consumers, investors, government agencies, local communities, NGOs, and industry associations.

Effective stakeholder engagement strategies include building partnerships, promoting dialogue, fostering collaboration to develop and implement climate change mitigation strategies, and involving stakeholders at all stages of decision-making processes.

Communication and trust-building are key elements of successful engagement as well educating stakeholders about the impacts of climate change on the agrifood sector, raising awareness about the need for collective action to address climate change risks and opportunities.

Involve stakeholders in decision - making process for climate change-related initiatives, policies, and investments is also key as well providing opportunities for stakeholders to participate in collaborative planning, implementation, and monitoring of climate change adaptation and mitigation measures.

Finally, collaboration and partnerships with industry peers, research institutions, government agencies, NGOs, and local communities, to address climate change challenges collectively, is also crucial.

Case studies from different regions, provide valuable insights on engaging stakeholders in climate change adaptation efforts in agriculture. Best practices include tailoring engagement strategies to local contexts, addressing power dynamics, and ensuring inclusivity and diversity among stakeholders.

3.3 THE ROLE OF THE BOARD: STRATEGY, DISCLOSURE AND ACCOUNTABILITY

The World Economic Forum in 2019 issued the Climate Governance Principles on "How to set up effective climate governance on corporate boards"[16] based on the awareness that this major transformation can only happen with a strong support from the top: an educated and motivated board should lead management to have the right time horizon and be ambitious to set winning strategies. There are clearly tradeoffs to manage – short versus long term – and uncertainties to face – mainly on regulatory framework and political support. This is why climate change is the ultimate governance challenge.

If the WEF initiatives[17] aim at promoting a greater business engagement on climate, regulatory authorities have put boundaries and obligations to ensure disclosure and drive behaviors: this increases the responsibility of business owners and boards and makes the transition plan not an option anylonger.

Europe has been at the forefront: since 2014 listed entities, banks and insurance companies have been required to disclose how they deal with climate-related risks and opportunities. Since January 1, 2024 the Corporate Sustainability Reporting Directive requires the same companies to take further steps in disclosure and commitment towards a green economy,

[16] https://www.weforum.org/publications/how-to-set-up-effective-climate-governance-on-corporate-boards-guiding-principles-and-questions/

[17] https://www.weforum.org/communities/agriculture-food-and-beverage/

starting from the 2025 publication of financial results for the year 2024. The same obligations will reach gradually smaller entities by 2028. More specifically, the new requirements include:

- to adopt plans (that include implementation / financial/ investment plans) to ensure coherence of their business with the transition to a sustainable economy and with the 1.5° limit under the Paris Agreement and the European climate neutrality target by 2050 and the 2030 climate target (so called fit for 55%);
- to fix greenhouse gas reduction targets for, at least, 2030 and 2050 and progression on them (making reference to conclusive scientific evidence and expressed in absolute value, i.e. gross targets);
- to show climate change mitigation (including reference to Scope 1, 2, 3) and adaptation projects;
- to explain how they consider water and marine resources, how they deal with circular economy, pollution, biodiversity and ecosystems.

The agrifood industry will be impacted directly (for its own obligations) and indirectly (for the requirement of their customers and financing institutions).

It is early to assess the impact of CSRD on the actual implementation of ambitious transition plans, but it will certainly drive a common language in Europe and will influence also players outside the EU.

Notably a growing number of Central Banks (starting from ECB) are taking steps to address biodiversity loss as a systemic risk to be managed in order to preserve ecosystems, as addressed by NGFS (the Network for Greening the Financial System, which includes more 100 central banks and supervisory authorities).[18] The interest from the financial sector on climate and biodiversity will bring to the agrifood sector more scrutiny but also more resources for the transition plan.

CONCLUSION

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