UNIVERSITÀ DEGLI STUDI DI PADOVA

DIPARTIMENTO DI SCIENZE ECONOMICHE E AZIENDALI "MARCO FANNO"

CORSO DI LAUREA MAGISTRALE IN ENTREPRENEURSHIP AND INNOVATION

Sustainable practices in the primary sector: emerging perspectives from the behavioural science

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2022/2023

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Firma (signature) ……

To my sister, I wish you to travel a lot, enrich yourself with experiences and achieve all your life goals.

To my grandmother Teresa, thank you for saving me whenever I needed it, I wish you to always be as stubborn and strong as you are for many more years together.

To my father, thank you for always protecting me even though you are long gone, I hope you can be proud of me.

To my mother, thank you for the support you have always shown me on this journey. I wish you deep peace of mind.

To my friends, who have shared with me the joys and difficulties in and out of university life.

To myself, for the commitment, love, determination, and ambition I have always put into what I do.

INDEX

LIST OF FIGURES

Abstract

This thesis explores strategies to change people's behaviour to promote respect for the environment, mainly in the primary sector. It first analyses the problem of the impact of human activities on the environment and compares some approaches that can be adopted to solve the problem. Particular emphasis is placed on people's behaviour, and possible solutions and strategies that can be adopted to encourage changes in people's behaviour are analysed. In particular, communication strategies are discussed to raise people's awareness, incentivize and disincentivize policies and stakeholder collaboration's. The thesis concludes with a final evaluation of the research results, aided by the analysis of field studies.

Introduction

We rarely consider alternatives because the majority of actions that we do every day are more like reflexes. Standing in an elevator or joining a ticket line aren't decisions. This is one of the reasons why introducing change is difficult: changing people's practices requires much work. Changing a social norm is as difficult as learning a new language because it requires breaking something that works. Replacing something familiar and natural with something new and foreign takes work. During social change, we ask ourselves if what we did before was correct. Many steps forward have been taken in the study and research of the most effective and appropriate ways of disseminating the message.

Our research question is: What can we do to make people, especially in the primary sector, change certain behaviours incompatible with environmental protection and climate change mitigation?

Climate change is one of the most urgent challenges of our time. The Earth's population is at risk due to the average increasing temperature of recent decades, causing significant consequences for the environment and society.

The leading causes of climate change are related to human activity, particularly greenhouse gas emissions, produced by industrial processes, transport, agriculture and energy production. These greenhouse gases, such as carbon dioxide and methane, capture heat from the sun and trap it in the atmosphere, causing global temperatures to rise and triggering phenomena such as melting glaciers, rising sea levels, floods, droughts, fires and storms. The effects of climate change are widespread and include the loss of biodiversity, desertification, dwindling water resources, food shortages, the spread of diseases and the increase in extreme weather events. Countering climate change requires innovative measures and integrated strategies at the global level, such as the adoption of clean technologies, the promotion of renewable energy, the sustainable management of natural resources, the reduction of greenhouse gas emissions and the rise of sustainable practices at the individual and collective level. Only with a shared commitment and a long-term vision will it be possible to combat climate change and protect our planet for future generations.

Climate change is having a significant impact not only on individuals but also on companies worldwide. The consequences of climate change in the corporate sphere can be observed through: changes in consumption patterns, rising commodity prices, stricter environmental regulation, increased natural hazards, and increased consumer attention. In the face of the impact climate change is having on companies, a strategic and appropriate response is required.

Companies have to keep up with the changing external world and market demands; those who lag behind risk losing part of the market, and therefore customers. Companies that adopt a sustainable and responsible approach can gain a competitive advantage and prosper in the long run.

The primary sector includes activities related to extracting and harvesting natural resources. This sector has agriculture, forestry, fishing, mining and energy production. Although these industries play a significant role in the global economy, they are also associated with several environmental problems. Agricultural practices suffer and cause pollution. The use of fertilisers, monocultures and genetically modified crops can lead to the loss of biodiversity. Deforestation and commercial fishing activities contribute to erosion and loss of habitats and biodiversity. Extraction of oil, gas and coal can lead to the release of toxic chemicals, which can contaminate watersheds and cause adverse effects on wildlife and human health. The environmental problems associated with the primary sector require developing and implementing sustainable and environmentally friendly practices. Cooperation between countries and stakeholders is necessary to ensure a healthy environment and a prosperous economy.

Trendsetters are individuals who significantly influence the thoughts, opinions and actions of those around them. In a network, trendsetters can be identified as highly connected and respected by their peers. They are more likely to be the first to adopt new ideas, products or services and their behaviour and decisions are often imitated by other network members. The power of trendsetters, organisations, and individuals can implement more effective and efficient behaviour change programmes. Peer support programmes that recruit and train trendsetters can effectively promote behaviour change in communities; this can be seen in the agricultural sector in the experiment studied by Beaman et al. and explained in chapter four.

Based on the material resulting from the research, the present work is structured as follows:

- The first chapter deals with the remarkable climate change phenomenon, providing the definition and key concepts to understand it better. Then the causes and effects of this phenomenon on our society and our future are analysed. In particular, the impact of environmental problems on our workplaces, companies and what can be done by each of us will be investigated. The concept of the circular economy and sustainable development will be introduced. The chapter concludes by examining the obstacles involved, the costs of climate change, and potential solutions to limit the phenomenon.

- The second chapter helps to understand the relationship between climate change and the primary sector. Starting with an overview of primary industry and its importance in our society, it then goes on to assess the problems it causes and the problems it suffers from climate change. The goals of sustainable development in the 2030 Agenda are then outlined.
- The third chapter studies diffusion within networks. The chapter begins by explaining the importance of interactions within a network, how people are connected, and the ties that can be created. It then discusses the possible economic incentives that can be given to encourage the adoption of sustainable behaviour and those that have been put into practice, particularly within the European Union. Then, some other solutions that can be applied to societies are discussed. It then discusses the importance of trendsetters, who play a central and influential role within the network, often identify themselves as early adopters and are often seen by others as an example to imitate. The chapter concludes by outlining some strategies that can be deployed to favour dissemination.
- The last chapter talks about experiments that test dissemination strategies: the Malawi experiment and the hybrid corn experiment. The first is based on a three-year investigation in some regions of Malawi where the diffusion of a new cultivation method has been studied: pit planting. This method brings many benefits to farmers, especially in arid lands such as those where this study was carried out, because it allows a greater concentration of water and hydration for the product sown, being closer to the surface and allowing the maintenance of natural nutrients in the soil. The second study concerns the diffusion of the hybrid panicle during the last century; it was a new product for the populations that brought several improvements to the farmers who adopted it. It then analyses how this product spread and the critical role played by those who first adopted it and recommended it to their neighbours in the network.

In conclusion, in this thesis, I analysed the importance of acting on social networks to counter negative environmental consequences such as climate change through the careful use of influence and the planned dissemination of innovative and valuable technologies for the purpose.

CHAPTER I – An overview of climate change

Over the years, we have seen how the world in which we live has undergone many changes: technological developments are the most tangible and the ones on which much attention is focused. But there is one change, which, while less visible than the one mentioned above, is far more charged with consequences for our planet and, therefore, for our lives: climate change.

Climate change is one of the most urgent challenges of our time. The Earth's average temperature has steadily increased in recent decades, with significant consequences for the environment and society. The primary causes of climate change are linked to human activity, particularly the emission of greenhouse gases into the atmosphere, such as CO_2 produced from the combustion of coal, oil, and natural gas, as well as deforestation and other land use changes. However, potential solutions to address the issue include transitioning to clean energy sources, implementing sustainable land use practices, and improving energy efficiency. In this context, it is crucial to understand climate change's causes and potential solutions to take effective action to mitigate its impact on the planet.

The chapter will begin with a description of the concept of climate change, its causes and consequences. We will then look at how companies suffer and, at the same time, contribute to climate change.

1.1 Definition and concept

When it comes to the phenomenon of climate change, the *Intergovernmental Panel on Climate Change* (IPCC) is the world's leading scientific authority. The IPCC was set up in 1988 by the *World Meteorological Organization* (WMO) and *United Nations Environment Programme* (UNEP) to provide policymakers with regular assessments of the scientific basis of impacts and future risks of climate change as options for adaptation and mitigation.

Climate change can be defined as the long-term shifts in temperatures and weather patterns. This phenomenon can be caused by natural events or by human activities.

1.2 Causes and effects of the greenhouse effect

One of the most visible effects of climate change is global warming; the earth's pollution has damaged the balance of the greenhouse effect.

We living beings can live on this planet due to the atmosphere, a thin gaseous layer formed by various gases. These gases also allow us to survive directly (for example, thanks to components such as oxygen O_2 and carbon dioxide CO_2) or indirectly, ensuring that the earth's temperature

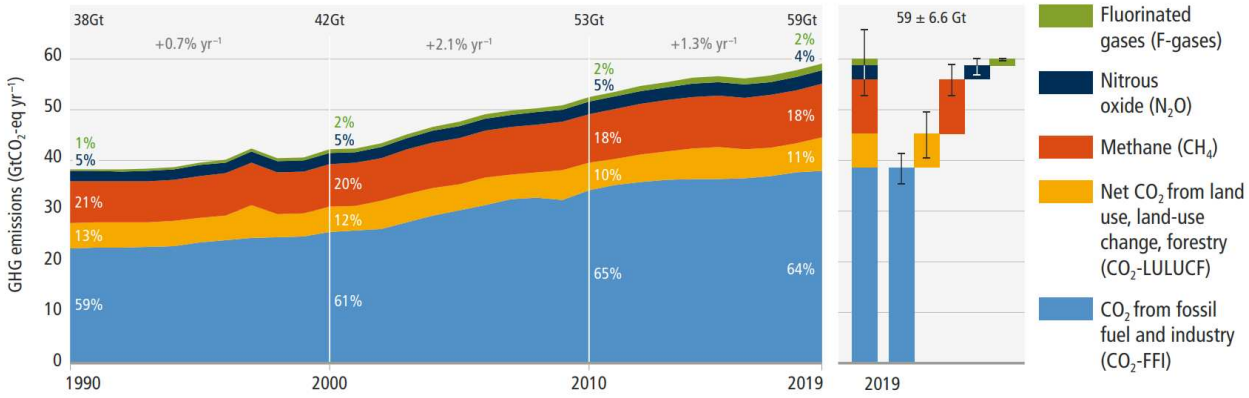
is adequate for life. This occurs naturally through the process in which the world retains some heat from solar irradiation.

To protect species that would otherwise experience difficulties due to excessive heat, almost all radiation is emitted back from the earth's surface and absorbed by clouds and carbon dioxide. In this way, it will be sent back outside the planet. All this causes a build-up of energy in the atmosphere, warming to an equilibrium condition in which the average temperature across the globe reaches 15 degrees Celsius.

Thus, the greenhouse effect is a natural phenomenon; it becomes a problem when there is excessive accumulation of greenhouse gases, such as carbon dioxide, methane and nitrous oxide, in the atmosphere. The growth in the amount of carbon dioxide is attributable to the extensive use of fossil fuels, while that of methane and nitrogen oxide is given by agriculture.

With a probability of more than 90%, the average global influence of human activities since 1750 on global warming is expressed as a radiative forcing1 of +1.6 W m-2. While that of natural factors has a radiative forcing of only +0.12 W m-2. (Schiavon, Zecchin, 2007).

Figure 1 - Global net anthropogenic GHG emissions 1990–2019



(Source: IPCC, 2022: Summary for Policymakers)

As reported in the IPCC Report 2022 by Biesbroek, R., Bowen, K., & Lawrence, J. (2022): "Anthropogenic climate change has exposed ecosystems to unprecedented conditions over millennia, which has greatly impacted species on land and in the ocean."

Among thousands of species spread across terrestrial, freshwater and marine systems, more than half have shifted toward earlier spring events and their range to higher latitudes. This phenomenon causes the reduction of biodiversity due to the displacement of some species to

[1] Radiative forcing is a measure of the influence of a factor, such as increased carbon dioxide in the atmosphere, in altering the balance of incoming and outgoing energy in the earth-atmosphere system.

other territories and, consequently, the modification of the ecosystem, including the lack of nourishment for the specimens that survive in the environments they are accustomed to.

At the same time, the ecosystem of the colder territories hosting the new specimens becomes homogenised: food webs are altered, and the distinctiveness of the community residing in that environment is reduced. Another problem resulting from global warming is the loss of specialised ecosystems; it can be observed that territories such as the Arctic or Antarctic are losing their distinctive features because glaciers are thawing. Warming has consequences such as reducing ice cover and thawing permafrost: a changing hydrological cycle has resulted in the contraction of polar and mountain ecosystems. This can be proven by the patterns of change in the Antarctic terrestrial and marine environment, such as the reduction in the ranges of krill and emperor penguins. In addition to rising temperatures, one fact that is bringing relevant problems is the accentuation and intensity of extreme weather events, including droughts, wildfires, terrestrial and marine heatwaves, cyclones and floods. These events affect the land and especially vulnerable people: they alter food (the marine environment is changed, agriculture is affected, and food safety is reduced due to the increases in toxigenic fungi on many food crops), they destroy entire villages, and those most at risk are those who live on islands or near the coasts.

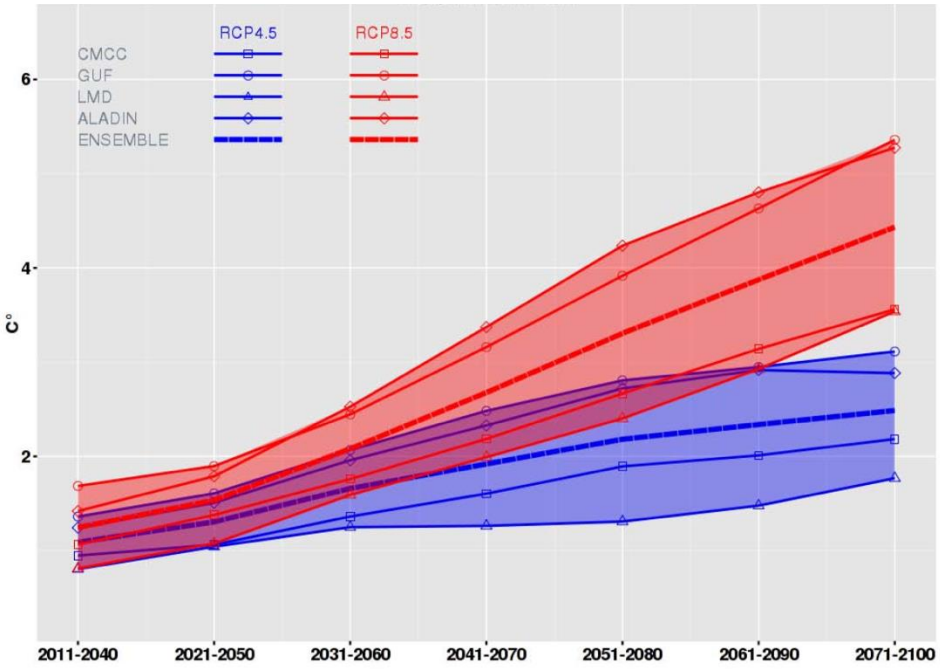
Regarding the risk resulting from the increase of these phenomena as reported in the IPCC 2022 report:

> *"Human populations exposed to extreme weather and climate events are at risk of food insecurity with lower diversity in diets, leading to malnutrition and increased risk of disease. [...] Climate-related extreme events are followed by negative impacts on mental health, well-being, life satisfaction, happiness, cognitive performance and aggression in exposed populations."*

Figure 2 represents the changes in the values predicted by the four models (averaged over 30-year periods) in the two scenarios, RCP4.5 (blue) and RCP8.5 (red). The coloured area represents the spread of the model's predictions, while the dashed line indicates the average of the changes predicted by the models (ensemble mean). According to studies, assuming the situation remains as it is, temperatures will rise steadily, as shown in Figure 2, compared to the Italian case. This indicates that action must be taken right now to take good initiatives. The United Nations Emissions Gap Report (2020) mentions that ensuring a safe future must be below the 1.5°C mark. To do this, the world must cut 30 gigatonnes of greenhouse gas emissions annually by 2030. We need to cut carbon emissions by managing our land and

resources more efficiently, including building “smart cities” and curbing deforestation and food waste.

Figure 2 - Average temperature



(Source: Il clima futuro in Italia, ISPRA 58/2015)

1.3 The effect of climate change on companies and society

Environmental issues are increasingly finding their way into society, particularly in companies. Numerous projects have been initiated and incorporated into organisational and social processes. This growth in attention to these issues is favoured by legislation and the growing awareness of its importance on the part of every citizen. Large companies and new start-ups are seizing the challenging environment to find methods to flank and support them with "green actions" for their business. In many cases, marketing is a valuable tool for publicising the actions taken and raising awareness of environmental issues. As Moliterni et al. (2018) assert, the global dimension and the extended time horizon in which the physical impacts of climate change verify contribute to underestimating the problem of climate change. The uncertain predictability of the consequences leads people to undertake only short-term actions, but they are viewed as decisions that can be postponed. This underestimation has prevented, until very recently, from having a real vision of the problem. It has slowed the planning and implementation of appropriate strategies to adapt to and combat the phenomenon. Thus, a 'time mismatch' between perception, action and impacts entails real risks: the environmental balance and people's lives on planet Earth are under threat, just as global economies and markets are strongly affected. Climate change impacts numerous aspects, including human health (air

pollution, damage to crops, lowered quality of food, meat, and many other situations that damage the human body), animal and plant life on earth, and the world economy. Regarding the economic effects, climate change can significantly impact the world's economies. The results of climate change, such as rising sea levels, more frequent natural disasters, and extreme weather conditions, can damage infrastructure, decrease productivity, and disrupt supply chains. This can lead to increased costs for businesses, governments, and individuals. In addition, climate change can also affect industries that rely on natural resources, such as agriculture and fishing, reducing yields and lower profits. Overall, the economic impact of climate change and the other consequences is a complex and multifaceted issue that requires proactive and comprehensive solutions to mitigate its adverse effects. For this reason, it is necessary to be aware of the present situation and the urgency to take the required actions. The later we become aware of the problem and take mitigating action, the greater the risk of failing to limit the damage. This is because the more damage is done, the greater the difficulties will be remedied. Once the situation has gotten out of hand, reversing the course will require many more resources than would have been used when the case was still 'under control'.

In recent years, scientific evidence and solid environmental communication have finally awakened the attention of many international actors who are working to raise everyday awareness of the concreteness of the consequences we will face. Thanks to the fame of certain people, it is possible to have access to a wider audience; people who are seen as idols are imitated, and their opinion often influences the thinking and actions of others. Prominent personalities such as actors or singers, by making their voices heard, increase the importance given to phenomena; by putting their faces and voices alongside these causes, they raise awareness of climate change. Although not famous, the young Swedish activist Greta Thunberg contributed to the campaign on these issues. She decided not to go to school in the parliamentary elections on 9 September 2018. By sitting in front of the Swedish Parliament and handing out information leaflets on the risks of climate change, she wanted to demonstrate against her government's inaction on environmental issues and demand that the Swedish government comply with the Paris Agreement on reducing CO_2 emissions. Her strike and young age drew the attention of journalists and newspapers, making her story go viral. After the election, Greta continued to strike every Friday; from this decision, the "Friday for future" events were born. So many people felt that they wanted to share in this struggle, and in March 2019, the first global Fridays For Future strike was held, with more than 1.6 million people demonstrating in over 125 countries. Other notable figures have been involved in pursuing climate change awareness initiatives over the years, one of them being Leonardo Di Caprio. Thanks to these

figures, curiosity and knowledge about these issues grow in people who admire the person and get involved.

Small actions can be done by every single person living on this planet, but a preponderant role is played by companies and those who run them. In addition to participating in their activities in the causes of climate change, companies suffer most from its effects.

1.4 Companies and climate change

Many companies are under pressure to reduce their greenhouse gas emissions, a significant contributor to climate change. Governments worldwide are implementing regulations and policies to reduce carbon emissions and promote more sustainable business practices. Investors are also increasingly concerned about the environmental impact of the companies in which they invest and are demanding greater transparency and accountability from these companies. In addition to reducing emissions, companies must also adapt to taking into account the impacts on their operations provided by climate change: extreme weather events, such as floods and droughts, can disrupt supply chains and cause financial losses.

The challenges posed by climate change are significant, but companies have an essential role to play. By taking proactive steps to reduce their greenhouse gas emissions, build resilience, and promote sustainability, companies can not only help to address this global crisis but also create long-term value for their shareholders and contribute to a more sustainable future for all.

1.4.1 Sustainable development

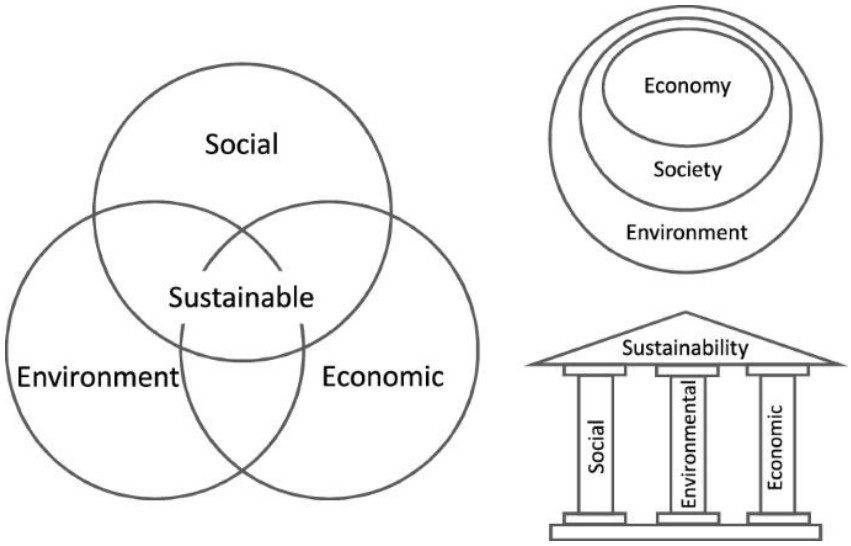
The issue of sustainability within the business is a key one, with companies dedicated to directing their business toward sustainable development.

As Brundtland H. (1987) explains:

> *"Sustainable development is not a fixed state of harmony, but rather a process of change in which the exploitation of resources, the direction of investment, the orientation of technological development and institutional change are consistent with future and present needs."*

Sustainable development is based on three principles of sustainability that were first mentioned in the Brundtland Report in 1987. A balance can only be achieved when environmental protection, social equity and economic viability coexist without the prevarication of one area over others.

Figure 3 - Three pillars of sustainability



(Source: The Concept of Sustainable Economic Development, Barbier 1987)

For centuries we have followed the logic of the linear economy: take, make and dispose of, but since the 1970s (Meadows, Meadows, Randers, & Behrens, 1972), it began to be seen that this method, in addition to being inefficient and costly, has been, and still is, a significant cause of such phenomena as marine and terrestrial pollution, the emission of greenhouse gases, and the resulting climate change that is creating more and more damage.

For these reasons, as well as because of growing attention and sensitivity on the part of businesses to environmental and social issues, there has been a need for an alternative model of production and consumption that is more capable of combining reconditions, well-being and growth with respect for and protection of the environment (Di Maria, 2018).

This new model concerns the circular economy, which requires a relevant change in consumer behaviour, and focuses on recovering material flows instead of generating excessive waste (Planning, 2015). The circular economy gives people the tools to tackle climate change and biodiversity loss while addressing critical social needs. In addition, it provides the power to grow prosperity, jobs, and resilience while cutting greenhouse gas emissions, waste, and pollution. In recent years, there has been more and more talk about the circular economy; look at how the number of articles has grown from thirty in 2014 to more than a hundred in just two years (Kirchherr, Reike, Hekkert, 2017). The concept of the Circular Economy is relevant because it represents an effective method for sustainable development. The growing population is forcing us to make important decisions about the economic models on which the production and consumption cycle is based. Hence, a circular model allows for reusing resources that would otherwise be wasted.

The Ellen MacArthur Foundation (2015) provided the following definition of the new model:

"A circular economy is an industrial system that is restorative or regenerative by intention and design. It replaces the 'end-of-life' concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models."

The concept of circular economy can be contrasted with that of the linear economy. In a linear economy, all resources are extracted from the environment to produce goods with relatively low average use and eventually destined for landfills. While the goal of a circular economy is different, most resources are reused through recycling. The product is then used as much as possible by extending its life through remanufacturing and reconditioning; it is about to create a closed loop. Even in the circular economy, there will be residual waste, which will be minimal compared to a linear economy.

Figure 4 - Difference between circular and linear economy

(Source: The Maker Movement and the Disruption of the Producer-Consumer Relation, Unterfrauner, 2017)

The shift from the traditional idea of consumption to the more contemporary concept of product use is central to the principles of the circular economy. While the consumption model focuses on the linear process: of extraction, production, and disposal, the circular economy emphasises the need to extend the life of products and materials through sustainable design and responsible use. This model aims to reduce waste, conserve resources, and minimise environmental impact by encouraging product reuse, repair, and recycling. For this reason, it helps to develop the first pillar of sustainability: environmental protection. The circular economy contributes to achieving environmental protection goals by promoting sustainable design, resource efficiency, and responsible consumption patterns by using renewable energy, reducing greenhouse gas emissions, and minimising waste through recycling and repurposing.

The circular economy is about reducing waste and promoting resource efficiency; it also aims to promote social sustainability by creating new opportunities for economic growth, job creation, community development, and other social actions. The circular economy supports the second pillar of sustainable development: social sustainability, which refers to initiatives supporting social issues, such as poverty alleviation and promoting diversity and inclusion. Products are manufactured where workers are not exploited; raw materials are treated with quality products and processes that do not undermine the health of those working on them, as usually happens with low-cost products. Companies that have structured their business with the circular economy in mind often also promote the work of small communities by giving them a way to work pretty and honouring their traditions. Several associations promote the development of ethical and sustainable production activities: Clean Clothes[2], Ethical Trade[3], Fashion Revolution[4] and Redress[5].

The last pillar of sustainable development is economic sustainability which considers economic viability, profit and other economic elements. Financial sustainability is a vital principle of the circular economy that helps create new opportunities for innovation and entrepreneurship. In addition, by encouraging the development of new business models to prioritise resource efficiency and waste reduction, the circular economy can help drive economic growth and job creation.

This is demonstrated by the fact that to achieve long-term economic sustainability, it is necessary to know that present resources are limited. Therefore, it is only possible to achieve the goal if one plans a sustainable strategy in multiple areas. Being aware that resources are scarce, the company has to adjust operations and strategies to stay resilient.

Based on the previous statements, the company must reorganize its activities in such a way as to enhance and maintain the resources that favour sustainable practices and long-term profitability. Internal analysis can be considered as a key tool to help companies in this transition. On the other hand, the company should eliminate or modify all the working methods

[2] It is an international network founded in 1989 and consists of more than 230 organisations aiming to improve the indignity of working conditions in the fashion industry: fair contracts, solidarity, safe workplaces and gender equality. For further information: https://cleanclothes.org/

[3] It brings together companies, trade unions and voluntary organisations with the aim of understanding what steps companies should take to trade ethically and how to make a positive difference in workers' lives. For further information: https://www.ethicaltrade.org/

[4] It is an 'action-oriented, solution-focused charity: decent work, discrimination and fair pay. For further information: https://www.fashionrevolution.org/

[5] It is a charity focused on the environment: encouraging the circular economy, reducing water waste, carbon emissions and using chemicals/toxic substances. For further information: https://www.redress.com.hk/

and resources that are not supporting long term profitability and sustainability issues. Of course, this process implies that the company needs to find alternative resources, business models and methods that support its transition towards a more sustainable production process.

At the same time, the company is interested in communicating its long-term program to its employees and stakeholders to work together toward a unique objective. Building essential resourcefulness and efficiency within the company is important and can be critical to its long-term success in the face of scarcity. Some companies might need to realise the scarcity of resources; in this case, the government should intervene. One example would be the practice of incentives and punishments: the government can tax unsustainable practices, such as excessive emissions or waste dispersed into the environment, while it can subsidise the most virtuous companies.

Common standards and certifications have been established to assess adherence to sustainability within companies: some are Fairtrade, Rainforest Alliance, and GLOBALG.AP, spanning sectors such as agriculture, fisheries, forest management, and mining operations. These certifications are essential in objectively assessing compliance with sustainable business practices and communicating to consumers which items are produced sustainably. Therefore, the company is no longer evaluated solely from the economic side; investors and non-investors use ESG[6] assessment that involves all three pillars of sustainability.

1.4.2 A green communication

The growth in the importance and urgency of these issues is leading toward modern environmental communication that conveys knowledge to the scientific community and to the broader public. Companies, for example, nowadays strive to bring a responsible message through which they build a good reputation. The social and environmental sustainability of the product is marked, and campaigns are promoted in favour of disadvantaged classes or for environmental protection.

In the latter case, as reported in the essay "Green Marketing. The Manifesto" (Grant, 2008), it is necessary to recognise that environmental goals can be basically of two types:

> *"They can be about changing what people do or how they see the world. In the second case, it is a wide-ranging goal because it addresses consumption patterns,*

[6] ESG assessment includes the following factors: Environmental, Social, and Governance. These are three critical dimensions for verifying, measuring, monitoring, and supporting (through product purchases or investment choices) a company's or organization's commitment to sustainability. (Di Biasi, P., Resti, A., Esposto, R., et. al. 2021)

lifestyles [...]. If you convince someone to recycle, that only reflects on other activities. Introducing him instead to low-impact eating will spill over many other types of behaviour."

The line followed can benefit the whole elements of sustainability: economy, environment and society.

A crucial part of environmental communication by businesses concerns HOW the message is conveyed. Nowadays, based on advertisements, all companies are turning to green companies. Many are using the practice of greenwashing[7] (Furlow, 2010). Green communication is integral to corporate social responsibility (CSR) and sustainability reporting, as it helps build trust and credibility with stakeholders. This type of communication is sincere and conveys the company's actual values. In contrast, companies that practice greenwashing communicate a different message from reality. It is a way of deceptive marketing focused on misleading consumers into believing that a company is more environmentally responsible than it is. A case was seen with the BP[8] company and its 'Beyond Petroleum' campaign, in which it claimed to have made considerable investments in renewable sources while at the same time remaining one of the world's largest oil and gas producers.

To best assess which companies are the ones that are really in environmental protection activities, it is necessary to pay closer attention to the materials used to assemble products or do research on the processes they use.

Customers can watch out for some signs to make it easier to detect companies that are greenwashing. In particular, they can rely on the official certifications that companies present—the presence of sustainability certifications we mentioned earlier, or the social report of the company can help. The latter is a summary document of the environmental reporting process. It has information that satisfies the interest of various stakeholders who participate directly or indirectly in the company's life. Shareholders may find summaries regarding economic performance, employees regarding working conditions; customers may have information on product quality and the social and environmental impact of activities, etc.

A culture of respect for the environment must be shared throughout the company, from the employees on the front lines conceiving and producing products to the managers who must outline guidelines for behaviour in the performance of work activities. The task of making

[7] Greenwashing is the dissemination of false or incomplete information by an organization to present an environmentally responsible public image. (Furlow, 2010)

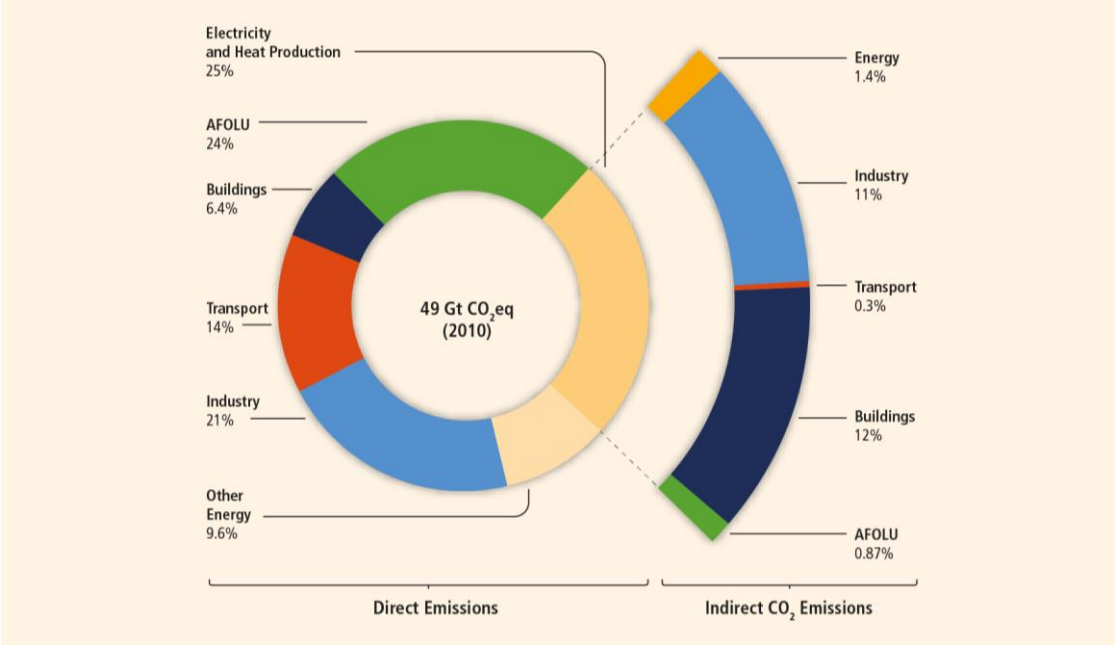
[8] Source: https://www.theguardian.com/environment/2008/nov/20/fossilfuels-energy

unconvinced employees understand the relevance of these issues lies on managers who, through disseminating the company's environment-friendly philosophy, must succeed in conveying its importance. At the same time, the media's attention to these issues is increasingly influencing consumers, who are now looking, with increasing determination, for brands and products that comply with sustainability principles. There are campaigns to raise awareness that can suggest how the customer can recycle or reuse the company's product packaging or practices that can be put in place to reduce one's impact in everyday life. The government or NGOs carry on these campaigns. An essential element to remember is action-oriented engagement through goals that are easy to communicate and applicable worldwide (considering national development levels). Engaging all business associates, stakeholders, and the press is essential.

1.4.3 Hurdles and costs due to climate change

Due to climate change, businesses, industries, utilities and multi-utilities are already facing several significant issues: increased operating costs, reduced asset value (stranded assets) and reduced demand for goods and services. Many studies have been conducted to understand climate change's impact on our world's economy. The Climate Finance Observatory of the School of Management Politecnico di Milano carried one out. It was estimated that in 2018 there was a correction of economic activities amounting to 133 billion euros (Croce A., 2021).

Figure 5 - Greenhouse gas emissions by economic sectors



(Source: Edenhofer et al., 2014)

Figure 5 represents the total anthropogenic GHG emissions by economic sectors. The inner circle showed five economic sectors' direct GHG emission shares (% of total anthropogenic GHG emissions). Pull-out shows how indirect CO_2 emission shares (% of total anthropogenic

GHG emissions) from electricity and heat production are attributed to sectors of final energy use. 'Other Energy' refers to all GHG emission sources in the energy sector as defined in Annex II other than electricity and heat production. The emissions data from Agriculture, Forestry and Other Land Use (AFOLU) includes land-based CO_2 emissions from forest fires, peat fires and peat decay that approximate to net CO_2 flux from the Forestry and Other Land Use (FOLU) sub-sector (IPCC report, 2021).

We have just analysed which sectors contribute the most to climate change; let us now see which sectors are most affected by climate change. Analysing the consequences of climate change revealed different impacts on the various sectors. Those who bore the brunt were the construction and mining sectors in terms of turnover and margins. The finance sector suffered losses in directly conducted activities and setbacks related to financed companies. At the same time, the retail sector managed to limit its losses to -4.5% in turnover and -3.1% in the margin (Croce A., 2021).

It is a different story for the sectors of agriculture, tourism and transport, which, contrary to the expectations of the average citizen, managed to keep loss rates low, reducing potential damage.

Taking the example of the insurance and banking sector ten years ago, carrying out a company's risk analysis was different. A bank would only consider climatic factors in exceptional cases and only for certain types of companies; today, this is no longer the case.

It has become essential to take these variables into account even for companies that are not directly exposed to catastrophic events but perhaps are because of their supply chains. This is why banks and insurance companies must reorganise their internal data analysis structure according to this new information and new sources, including energy transition risks and risks related to the evolution of business models that companies face. Today, the insurance industry offers coverage policies to reduce vulnerability and hazard (defined by the frequency and intensity of the catastrophic event) based on determining the economic exposure value of a given territory.

In any case, no sector will be exempt from the consequences of climate change, as will society at large. The well-being of humanity depends on the availability and distribution of food. Lobell and Field (2007) showed that rising global temperatures since 1981 have already reduced global harvests of maise, wheat and barley (EUR 3.2 billion annual losses).

In the coming years, annual rainfall will increase in most of Europe, resulting in increased flood damage. Conversely, in the Mediterranean region, the frequency and duration of drought periods will increase: by the end of the century, soils in these areas will be arid (Sheffield and

Wood, 2008). Global warming also affects specific products because it causes traditional environmental conditions to change: the maturing of cured meats, the ageing of cheeses or the maturing of wines are affected by ecological change. Due to overheating, bananas and avocados are being grown in Italy and at the same time, cocoa plants in West Africa, where the climate is becoming drier, are at risk. The greenhouse effect cuts barley and hops crops' yield for traditional Belgian and Czech beer. In the same way, French champagne producers are alarmed by the almost 1.2 °C rise in temperatures over the past 30 years in the growing area, so much so that leading scientists have speculated that the most suitable growing areas are being moved to England.

Another major problem that will affect, and already is acting, is the reduction of available energy. Studying the hydropower production system in the Swiss Alps, it can be predicted that hydropower production will drop by 36% in 2070-2099 compared to 1961-1990, again due to global warming (Schaefli et al., 2007).

In addition, some mathematical models tell us that wind speeds will increase in southern Sweden due to global warming, with consequences for the Swedish timber industry (Blennow and Olofson, 2008).

The future scenario, therefore, foresees increasing difficulties in finding raw materials due to weather disasters and global warming, which will increase the cost of the resources that can be found. This cost will then also be passed on to consumers. In addition, if some companies fail to supply products due to a lack of raw materials, they will also see damage to customer loyalty. Competing companies that manage to fill the gaps of the others could profit from making themselves known to customers. Another problem that could arise is the reduced quality of raw materials, which will reduce the finished and marketed product rates.

One cost to be considered in stemming the effects of climate change is investment by businesses and governments to promote structural changes in the global economy that favour low-emission industries and accelerate the green transition. Facilitating this evolution requires collaboration between the public and private sectors to build effective policies to drive change. Italy is among the most prosperous European countries in biodiversity: coastal dunes, high peaks, and numerous species of flora and fauna. This biodiversity ensures clean air, clean water, clean soil and many other benefits for the entire population. These elements also help to counter climate change naturally. Despite all these positive aspects, Italy has yet to have a wide-ranging strategic vision capable of laying solid foundations for environmental protection and ecological transition to be implemented soon as possible. The steps that need to be taken in this direction

can be done by starting with the formation of a figure who would be the guarantor of nature, who would be responsible for monitoring and soliciting the actions to be put in place by the various parties involved in the management and planning of an environmental activist. A Nature Code should encapsulate and schematise all nature legislation in parallel with the guarantor. In Articles 9 and 41, the Italian constitution declares the protection of the environment and ecosystems, with the declaration that free economic initiative cannot damage them. Based on these articles, we should therefore have more influence on the choices of companies to pollute, exploit and damage the environment. The government should put plans in place to raise awareness, incentivise and, if necessary, punish private institutions that harm the soil, the air and cause damage to flora and fauna. Programming climate neutrality by 2050 into legislation would incentivise economic planning in that direction, attract green investments, and increase corporate responsibility and citizen participation. The legislator should provide procedural rules that intervene preventively in authorisation procedures and allow for effective remedial action in the event of environmental damage. In this way, Article 41 of the Constitution would be put into practice, and the principle prohibiting significant ecological damage would be fully implemented. In the coming years, it is, therefore, necessary for the government to put the environmental issue at the centre of gravity of political and administrative action. Just as governments must commit to implementing these changes, companies must also be prepared to adapt to legislation and new green planning quickly.

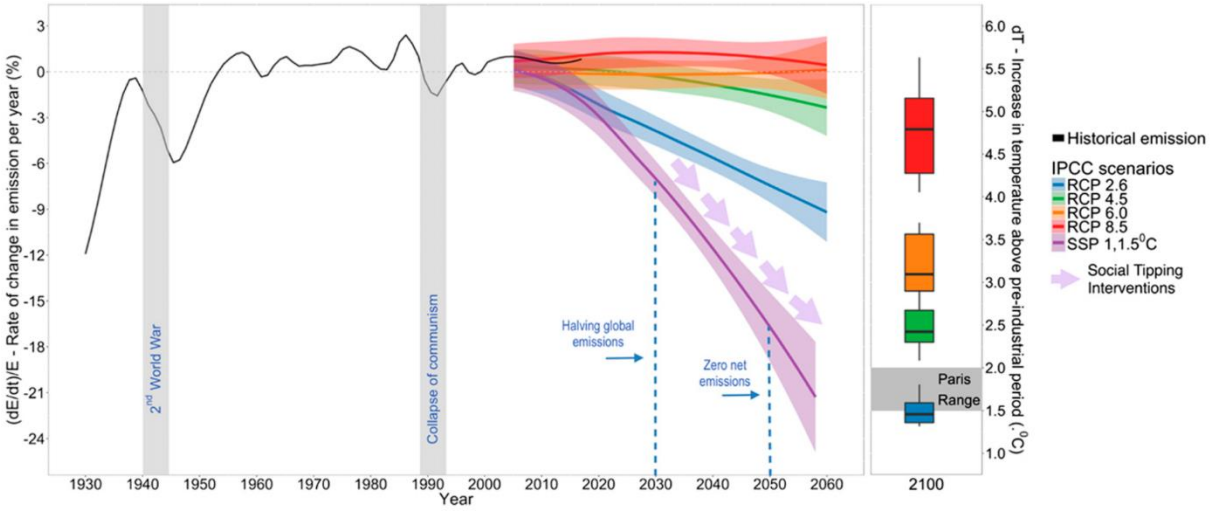
Based on the relative turning point[9], local economic and social systems must promote a more sustainable future to achieve the objective, i.e. a decarbonised economy capable of growing at higher rates than an equivalent carbon-intensive economy. The 'turning point' (or tipping point) in the transition to a low-carbon economy is the point at which there will be a significant reduction in greenhouse gas emissions, with a consequent decrease in the impact of human activity on the climate. Achieving this requires collective action: governments, businesses and individuals must work together towards the same goal. The world has begun to move towards a low-carbon future thanks to increased awareness of the ongoing climate crisis. The move to 'net zero' (emitting no more greenhouse gases than are removed) must happen with an urgency that surpasses previous industrial revolutions. The global economy is undergoing a process, and every company, government, organisation and individual has a role in accelerating this transition.

As Scott L. Corwin and Derek M. Pankratz (2021) explain in a Deloitte publication:

[9] When the benefits of the transition to carbon neutrality outweigh the corresponding costs, thus driving positive regional growth.

"The system-of-systems approach recognises that existing industries will be reconstituted as complex, interconnected, emissions-free systems—energy, mobility, industry and manufacturing, agriculture and land use, and negative emissions. Government, finance, and technology can play a catalytic role to underpin and enable the emergence of those systems. A diverse set of societal and economic forces—from fluid and shifting consumer preferences to the rise of stakeholder capitalism and growing demands for climate action now—can drive the transition."

Figure 6 - The rate of change in annual greenhouse gas emissions required for net decarbonisation



(Source: Social tipping dynamics for stabilising Earth's climate by 2050, Ilona M. Ottoa, 2019)

Looking at Figure 6, we can see that the left and right sides show the rate of change of CO_2 emissions per year between 1930 and 2060 and the global average temperature increase by 2100 compared to the pre-industrial period. The transition to a new state of net decarbonisation requires moving from an incremental increase in emissions of 0-2% per year to a non-linear decline of 7% per year and more. These data show how the current and future situation needs everyone's contribution, and urgent corrective actions are needed to achieve the goals necessary to safeguard the planet we live on and the well-being of human life itself.

Other relevant costs in the current scenario are educating and changing the mindset of staff. It's important to know that more than implementing the changes to the policies and procedures are needed, but instead creating a philosophy that values and believes in the importance of environmental issues. For this reason, when management decides to introduce green practices for production, it must be borne in mind that it will take dedicated resources to educate staff and make them understand the importance of these changes. This can be helped by the managers' transmission of the new corporate philosophy. When managers actively demonstrate

their commitment to environmental issues, it ripple effect on the entire organisation. If leaders try to educate their employees about the importance of environmental problems, it sends a powerful message to employees, making them feel appreciated and valued. Consequently, employees are more likely to share their managers' beliefs and values and adopt green practices. Employees are encouraged to do the same when they see their leaders consciously trying to lead sustainable lives and uphold eco-friendly behaviours. From reducing office waste and adopting energy-efficient appliances to implementing sustainable transportation policies and reducing carbon emissions, when managers show their belief in environmental issues, it positively impacts the workplace culture. It fosters a sense of community and collective responsibility for the planet that we all share. Embracing sustainable practices can significantly impact the environment and the world. Therefore, managers must take the lead and demonstrate their commitment to environmental issues. When the leaders prioritise this mission, it will help inspire the change in the world we all hope to see.

Other costs the company has to bear related to adapting all equipment to the green philosophy when going down this road and the prices to be devoted to communication and marketing due to this mindset change. It is essential to communicate to the outside world every step you take in the direction of a more environmentally friendly company. Building a communication campaign that conveys the company's relevance to green issues is necessary. Still, at the same time, it is essential that the product also communicates this so that consumers realise it for themselves.

Many companies today closely monitor their environmental impact, which is increasingly close to the hearts of many consumers. An example could be the Treedom company, where the customer chooses a tree to plant. But he will not receive anything physical at home; he will get updates via the online page. Each tree will contribute to reducing CO_2 on the planet and helping the farmer who plants it on his land. In this way, the customer feels part of the story of the project they are part of and contributes with this purchase to help both the planet and the farmer.

One of the most significant obstacles facing the company due to climate change is the problematic planning that the variability of environmental events imposes. In the primary sector, for example, uncertainty about the harvest and the health of animals (there may be a shortage of fodder to feed them) forces uncertainty about the future and, consequently, does not guarantee production companies a particular supply, either in quantity or quality.

In addition to damaging products, extreme weather events can damage farm structures, especially warehouses. In this case, the costs are very high and may necessitate the closure of

the business. This is why insurance companies, as mentioned earlier, have increased their range of services and have also included weather-related damage.

Some other factors that may hinder business activity (Deloitte, 2022) and have economic impacts are:

- Heat stress: Lost of labour productivity from extreme heat;
- Sea-level rise: Lost productivity land, both agricultural and urban;
- Damaged capital: Stalling productivity and investment;
- Human health: increased incidence of disease and mortality;
- Lost tourism: the disrupted flow of global currency;

1.4.4 Potential solutions

Everyone on planet Earth needs to work on two fronts simultaneously while striving to limit the impact of business decisions on the environment and climate change's impact on business activities.

There are several solutions that companies can implement to limit the worsening of climate change and reduce the risk to their business. The first solution is decarbonisation, i.e. eliminating more and more coal for energy production. In the Economists' Declaration on Climate Change published 1997, more than 2,600 economists, including 19 Nobel Prize winners, signed it. According to this declaration, the tax should increase yearly until it reaches a carbon-neutral level.

Another step that many should take is reforestation. This strategy increases the absorption of CO_2 in the air, thus contributing to the planet's preservation. Many companies with land not in use could apply this decision, mainly using smog-eating plants [10] (Acer platanoides, Betula pendula, Ginkgo Biloba, ...) to purify the air we inhale.

Instead, biochar, which enables the transformation of biomass into charcoal for burying, has recently begun to be applied. It has been discovered that this material is not harmful to plants and allows 5% of transport emissions within the EU to be captured. In addition to this, it retains water (thus coping with drought periods) and de-pollutes soils full of toxic substances (Kookana, Sarmah, Van Zwieten et al., 2011).

Regarding the problem of low pressure on the oceans, scholars suggest creating artificial rain using, e.g. Helium. Organic and Regenerative Agriculture is a treatment that allows agricultural waste to be reused to produce biogas. It is a new technique born in South America and spreading

[10] https://www.coldiretti.it/ambiente-e-sviluppo-sostenibile/piante-mangia-smog

in Italy. A project in San Vito dei Normanni, called XFarm: is a social farm that uses this regenerative technique on land taken from the mafia. The result is the production of 'Manifesto' oil. Another reality that uses regenerative agriculture is Novamont in Porto Torres, Sardinia, which uses bioplastics; the company is developing plant essences to make the soil more fertile while capturing CO_2.

A necessary action that we can all take is the preservation of the oceans: the dangers are the threat of intensive fishing (which reduces species and ruins the seabed) and the fact that the oceans are unfortunately often used as rubbish dumps. Companies can commit to respectful and careful disposal of waste and discards to minimise the negative impact on the environment.

One of the relevant actions put into practice is the incentives governments give to improve the energy efficiency of homes and businesses; this has been the case in Italy, for example, by 110%. The eco bonus has thus helped to encourage insulation work to reduce energy waste, safeguarding heat escape.

Several companies and individuals are also equipping themselves with solar and photovoltaic panels; these systems have different purposes. Solar thermal exploits solar radiation to produce heat, i.e. thermal energy for domestic hot water production. On the other hand, photovoltaics still harnesses the sun's power to produce electricity.

The installation of these systems brings numerous advantages, including:

- savings on consumption for heating;
- savings on electricity consumption;
- savings for the production of domestic hot water;
- greater environmental sustainability since a solar plant does not use fossil raw materials;
- improvement of the building's energy class and thus also of the property's monetary value.

In recent years, we are increasingly noticing the growing attention on plastics. Many companies have introduced packaging made of recyclable and environmentally friendly materials, although many more steps must be taken. An alternative to plastic can be the new eco-plastics being created: ecologically friendly production of polycarbonate products. Furthermore, sorting and separating waste is essential, especially for medium to large companies.

CHAPTER II – The primary sector and its relationship with climate

The primary sector, which includes agriculture, forestry, fishing, and mining, plays a significant role in the global economy and is closely linked to climate change. The activities of the primary sector can contribute to climate change through greenhouse gas emissions, deforestation, soil degradation, and water pollution. For example, the livestock sector is a significant source of methane emissions, a potent greenhouse gas contributing to global warming. For these reasons, in this chapter, we will also see the impact of intensive livestock farming on the environment and climate change and on possible solutions to reduce its consequences.

At the same time, climate change can also significantly impact the primary sector through changes in rainfall patterns, increased frequency of extreme weather events, and shifts in ecosystems. Therefore, addressing the linkages between the primary sector and climate change is essential to ensure a sustainable economic and environmental future.

The chapter will then begin with an overview of the primary sector and its relationship with the climate. Then, as mentioned above, we will focus on intensive livestock farming and potential solutions that could help reduce its impact on climate change. Finally, a brief mention of the 2030 agenda about the primary sector will be made.

2.1 An overview of the primary sector

Over the last fifty years, the primary sector in Italy has undergone significant changes. The primary industry encompasses agriculture, forestry, and fishing, which are traditionally essential to Italy's economy.

During the 1960s and 1970s, agriculture in Italy experienced a period of modernisation and expansion. This was partly due to government policies encouraging farmers to adopt new technologies and techniques. As a result, agricultural productivity increased, and Italy became one of Europe's leading wheat, rice, and wine producers. However, in the following decades, the primary sector faced several challenges. One of the main issues was the decline in the number of people employed in agriculture.

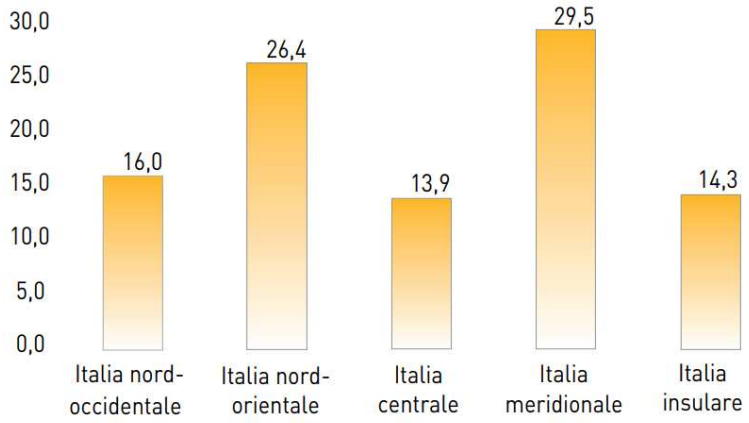
According to a study by the Italian National Institute of Statistics (ISTAT), the primary sector in Italy has experienced a significant decline in employment over the past few decades. In 1961, around 37% of the Italian workforce was employed in the primary sector, but by 2020, this figure had dropped to just 2.4%. This decline has been attributed to various factors, including adopting new technologies and automation, migrating young people to urban areas, and increasing competition from other countries (ISTAT, 2021). Italy faced stiff competition for agricultural products from other European and non-European countries, such as China and India. This made it difficult for Italian farmers to compete on price, leading to declining exports.

In the 1990s, the Italian government implemented several reforms to address these challenges. The Common Agricultural Policy (CAP) provided farmers with financial support and helped stabilise agricultural prices. The government also encouraged farmers to diversify their crops and focus on high-value products such as organic food and speciality crops. Despite these efforts, the primary sector in Italy continued to face challenges. In the early 2000s, a significant outbreak of foot-and-mouth disease devastated the livestock industry. This led to declining meat production and exports, forcing many farmers to leave the industry.

Despite these difficulties, the primary sector contributes significantly to the Italian economy.

With 32,858 million euros, agriculture accounts for 2.2% of the national added value. On the exact weight is the food industry, with 30,773 million accounting for 2.1% of the total. The report shows that 2018 refers to 415,745 enterprises for a total UAA of 8,265,094 hectares. Of these, 94.6% are represented by agricultural enterprises with a farm business and the remaining part by enterprises operating in support activities to agriculture, forestry, fisheries, and aquaculture. This has led to a focus on sustainable and traditional farming practices, such as organic and biodynamic farming, valued by consumers in Italy and abroad. (CREA, 2021)

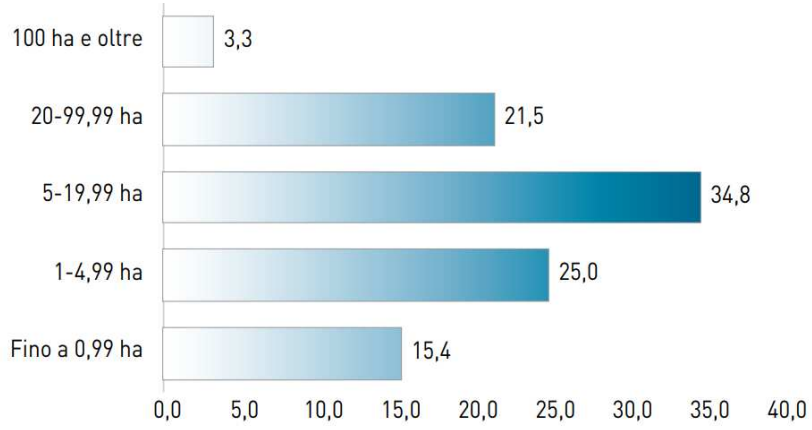
Figure 7 - Agricultural enterprises by a geographical breakdown: percentage share, 2018



(Source: Asia Agriculture register, ISTAT)

The physical size of agricultural enterprises is mainly small to medium: more than 40 per cent have an area of less than 5 hectares. Approximately 35% are enterprises with a space between 5 and 20 hectares.

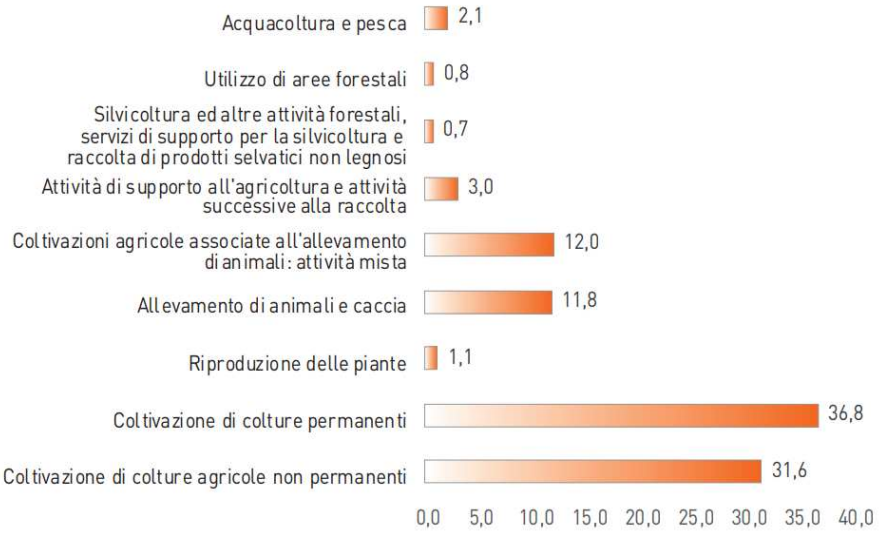
Figure 8 - Percentage distribution of economic units by UAA class



(Source: Asia Agriculture register, ISTAT)

Main economic activities carried out by the agriculture, forestry and fishing macro-sector enterprises focus heavily on permanent crops (over 36%) and non-permanent (just under 32%). There is also a significant presence of companies that combine cultivation with livestock breeding activities and those specialised in livestock farming alone, with other activities playing a secondary role.

Figure 9 - Percentage distribution of economic units by UAA class



(Source: ISTAT)

According to an ISTAT study, after the negative performance of 2019 (-1.6% value added in volume), with the crisis due to the Covid-19 pandemic, the agriculture, forestry and fishing sectors suffered a further marked contraction: in 2020 production in volume decreased by 3.2% and the value added by 6%.

The primary sector contributed approximately 2% to Italy's GDP in 2020 and accounted for 12% of its exports. The study also found that agriculture is the most significant component of the primary sector, contributing around 75% of its output.

Italy is renowned for its high-quality food and wine products, mainly produced by small-scale and family-run businesses.

The Italian government has recently introduced several initiatives to support the primary sector, including subsidies for young farmers, investment in research and development, and promoting organic farming. However, challenges such as climate change and the increasing demand for sustainably produced food remain. Overall, academic research suggests that the primary sector in Italy has undergone significant changes but remains an integral part of the country's economy and cultural heritage. With continued support and innovation, the primary industry in Italy has the potential to thrive in the years ahead.

2.2 Primary sector and environmental issues

I focused on the primary sector because it is made up of communities, which are numerous and tend to be small. Moreover, it is among the sectors where climate damage is most tangible to the eye of even the non-expert. It is, therefore, interesting to study how the industry is changing and how human beings can modify their behaviour to sustain the well-being of planet Earth.

Agriculture and climate change have a complex relationship that is intertwined in multiple ways. For example, agriculture is both a contributor to climate change and a sector that is heavily impacted by the effects of climate change.

On the one hand, agriculture significantly contributes to greenhouse gas emissions. The livestock sector, for instance, is responsible for around 7.1 Gigatonnes of CO_2-equiv per year, representing 14.5 per cent of all anthropogenic GHG emissions. (FAO, 2013) The use of synthetic fertilisers and the cultivation of rice also contribute to emissions. Additionally, deforestation for agricultural purposes releases carbon dioxide into the atmosphere, further exacerbating climate change.

On the other hand, climate change is causing significant impacts on agriculture. Changes in temperature, rainfall patterns, and extreme weather events, such as droughts and floods, affect crop yields and livestock production. This, in turn, can lead to food shortages, price hikes, and food insecurity.

To mitigate the negative impact of agriculture on climate change, sustainable farming practices such as conservation agriculture, agroforestry, and organic farming can be implemented. These

practices can help reduce greenhouse gas emissions, improve soil health, and increase resilience to climate change. For example, agroforestry involves growing trees alongside crops or livestock, which can sequester carbon and help protect against extreme weather events.

In addition, the agroforestry sector plays a significant role in the absorption of greenhouse gases, which are growing strongly and amount to 41.5 $MtCO_2$ per year, thanks mainly to the contribution of forests, meadows, pastures, and long-lived wood products, which act as net absorbers (carbon sinks). Another figure of interest for environmental issues is the increase in the area under organic farming, which has exceeded 2 million hectares, bringing the incidence of organic UAA[11] to 16.6% of the total UAA. Four Italian regions have exceeded the 25% target, and three others are close to reaching this threshold, set by 2030 by the Farm to Fork strategy. (CREA, 2021)

2.2.1 Livestock farming

As we have seen, the primary sector is closely related to climate change. A sub-sector of the primary sector concerns intensive livestock farming, and we bring an example of how to try to keep an area under control where it is essential to make innovations and changes in an environmentally friendly way. Intensive livestock farms are the part of the primary sector that contributes most to air pollution.

Intensive livestock farming has become an increasingly common practice in many parts of the world due to its ability to produce large amounts of meat, dairy and eggs at a relatively low cost. However, it has also been associated with various environmental problems, such as air and water pollution, greenhouse gas emissions, deforestation, and biodiversity loss. Article 44 (9) of Regional Law No 11/2004 defines intensive livestock farming as 'the complex of building structures and facilities intended for this purpose, also organised in industrial form, not functionally linked to an agricultural holding'. This is a regional law of the Veneto region. There needs to be a precise definition of intensive livestock farming at the European level. European law does not need it since it is a descriptive definition that does not affect lawfulness. In this case, if one wanted to aim for a regulatory purpose of intensive livestock farming, one would have to prove that the rules already established at the European level needed to be respected. Whenever the issue is presented where animal welfare and public health are compromised, and there are apparent failures to comply with the rules for emissions, slurry disposal, etc., the law would then need to qualify the livestock farm further. The only mention that is made concerns the listing of certain types of intensive livestock farms contained in Legislative Decree

[11] UAA: Utilised Agricultural Area.

152/2006 Environmental Regulations, which defines, in Annex VIII part 2, as intensive livestock farms with the following characteristics (Monfredini et al., 2021):

a) 40,000 poultry places
b) 2,000 places for production pigs (over 30 kg)
c) 750 places for sows.

Intensive livestock farming is often heard about because of many people's criticism and concerns about animal welfare.

The law does not help; it does not focus on protecting the animal but instead puts the economic side of the situation in front. Directive 58/98, which 'lays down minimum standards for the protection of animals kept for farming purposes', makes it clear just how much more critical the economic fact is than animal welfare: '...that differences that threaten to distort the conditions of competition hurt the proper functioning of the organisation of the market in animals ... that it is therefore necessary ... to facilitate the organisation of the animal market', meaning that the countries where people's sensitivities had obtained more restrictive legislation found themselves in a distorted competitive situation compared to those that did not have these rules, a distortion that Europe is trying to straighten out with Directive 58. (Monfredini R. et al., 2021)

In Italy, the Directive was implemented with Legislative Decree 146 of 2001. This generic legislation regulates minimum welfare conditions equal for all, regardless of the animal in consideration. Under pressure from the public, special regulations were issued in the following years, specifically for laying hens, calves and pigs. Therefore, the law does not help preserve animal welfare or facilitate the control of environmental pollution and climate damage. A brief mention should be made of the fact that underestimating animal welfare in intensive livestock farming leads to several problems for humans, including the risk of zoonoses and contributing to the development of antibiotic resistance. There are several consequences of intensive livestock farming on the climate. The most talked about is that greenhouse gases are released throughout the production chain to produce meat intensively. Firstly, in addition to the digestion of food, deforestation, which is practised to create cultivation areas to feed intensive livestock and to raise animals, releases gases previously stored in soil and vegetation. Furthermore, manufacturing synthetic fertilisers required for intensive animal feed crops uses fossil energy, resulting in significant CO_2 emissions. In addition to these problems, methane and nitrous oxide are produced in large quantities and released through different sources. These components are formed by animal manure, fermentation produced by ruminants during digestion and the use of fertilisers. Livestock farming has 37% and 65% of the world's methane and nitrous oxide,

respectively. These two gases are much more polluting than carbon dioxide. Beef and cattle milk production account for the majority of emissions, contributing 41 and 20 per cent of the sector's emissions. At the same time, pig meat and poultry meat and eggs contribute 9 per cent and 8 per cent to the sector's emissions, respectively. They included feed production, pasture and feed crops expansion into forests accounts for about 9 per cent of the sector's emissions. Cutting across categories, fossil fuel consumption along the sector supply chains accounts for about 20 per cent of sector emissions (FAO, 2013).

Another major problem of intensive livestock farming, linked to the environment, is the damage to biodiversity. Approximately 30% of global biodiversity loss is attributable to intensive livestock farming caused by deforestation, intensive agriculture, soil depletion and desertification (Bailey, Froggatt and Wellesley, 2014). From a climate change point of view, deforestation is the land-use change process generating the most GHG emissions. The debate surrounding the key drivers of deforestation and the attribution of GHG emissions to these drivers is ongoing. Within Latin America, 90 per cent of the soybean area expansion from 1990–2006 happened in Brazil and Argentina. Practically, his choice of 1990 discounts four years of land use change-related emissions, compared with the 20-year timeframe recommended by IPCC (FAO, 2013). A 2014 study by Bajzelj, S. Richards, M. Allwood, et al. (2014) shows that if the current agricultural and livestock intensification system remains, it will lead to a 77% increase in greenhouse gas emissions by 2050. These emissions alone could cause a global temperature rise of close to 2°. According to the same study, only by decreasing food wastage by 50 per cent and changing the diet will emissions from agriculture and livestock farming be able to drop. Among the diet change is the reduction of meat consumption, which would reduce the impact of intensive livestock farming on the planet. Reducing the consumption of meat, milk and eggs in the EU by 50% would reduce emissions by 25-40%. (Westhoek, Lesschen, Rood, et al. 2014)

2.2.2 Solutions to reduce the impact of livestock farming

Having seen how intensive livestock farming damages the environmental balance, we will now look at some proposals on how the effect of these facilities on the environment could be reduced.

Organic livestock farming fits in as one of the European strategies to respect the environment, water, land, air, and animals, after having instead considered livestock farming in the past century a place of extreme profit, with the noticeable environmental results that are there for all to see (exploitation, coercion, torture, etc.). In organic livestock farming, the fundamental thing is that environmental and moral parameters are not violated. An inspection of organic farms is

carried out by the inspectors of the ODCs (inspection bodies) as private bodies paid by the producer, even though they are specifically trained for this type of production.

Part of the mitigation potential can be animal health and herd management. In these areas where animal and herd efficiency is already high, mitigation can be achieved by improvements in other farm operations such as manure management, energy use and feed sourcing with lower emission intensity. (FAO, 2013)

Here are some proposals about the solutions that intensive livestock farms can implement to help minimise their environmental impact:

1. Improving Waste Management: One of the biggest challenges with intensive livestock farming is animal waste management. Manure from livestock can cause pollution of waterways and soil if not appropriately managed. One possible solution is to invest in modern waste management systems such as anaerobic digesters, which can convert manure into biogas for renewable energy sources. A 30 per cent reduction of GHG emissions is possible if producers in a given system, region and climate adopt the technologies and practices currently used by the 10 per cent of producers with the lowest emission intensity. (FAO, 2013)
2. Reducing Water Use: Livestock farming is a water-intensive industry, with estimates suggesting it takes around 1,800 gallons of water to produce just one pound of beef. To reduce water use, farms can invest in efficient watering systems, use recycled water for irrigation, and use drought-tolerant crops in their feed.
3. Using Renewable Energy: Livestock farms can help reduce their carbon footprint by investing in renewable energy sources such as solar, wind, and hydroelectricity. These energy sources can help reduce greenhouse gas emissions and provide farmers with cost savings.
4. Implementing Sustainable Grazing Practices: Livestock farming often involves clearing forests and natural habitats to make room for grazing. Implementing sustainable grazing practices can help reduce the environmental impact of grazing, such as soil erosion and degradation. This can include rotational grazing, where animals are moved between different pastures to allow vegetation to recover, or silvopasture, where animals graze in wooded areas.
5. Reducing Antibiotic Use: Antibiotic resistance is a growing problem, and intensive livestock farming significantly contributes to the issue. Farmers can reduce antibiotic use by improving animal health through better nutrition, vaccination programs, and

disease prevention measures. This can help reduce the risk of antibiotic-resistant bacteria developing and spreading.

Emissions from the production, processing and transport of feed account for about 45 per cent of sector emissions. The fertilisation of feed crops and manure deposition on pastures generate substantial N2O emissions, representing about half of feed emissions. About one-quarter of feed emissions are related to land-use change. Among feed materials, grass and other fresh roughages account for nearly half of the emissions, mainly from manure deposition on pasture and land-use change. (FAO, 2013) For these reasons, it is more and more essential to study how it is possible to influence people's behaviour to change practices that are causing damage to our planet.

2.2.3 Agenda 2030

The 2030 Agenda proves our realisation that a profound change is needed in our way of life, particularly in the global food and agriculture system.

Figure 10 - Sustainable development goals of Agenda 2030

(Source: https://www.santannapisa.it/en/outreach-impact/agenda-2030-17-sustainable-development-goals)

The seventeen Sustainable Development Goals that make up the 2030 Agenda refer to different areas of social, economic and environmental development, which must be considered in an integrated manner, as well as the processes that can accompany and foster them sustainably.

Food and agriculture offer critical development solutions and are vital for eradicating hunger (2), poverty (1) and climate change mitigation (13).

The primary sector comprises small farms; they provide 80% of the food consumed in the most developed world. Therefore, investing in smallholder farmers is the best way to increase food security, the nutrition of the poorest, and food production for local and global markets.

Climate change is increasing pressure on the resources we depend on, and our soils, rivers, oceans, forests, and biodiversity are degrading rapidly. Agriculture, forestry and fisheries can provide nutritious food for all and generate adequate incomes, but they need to be better managed than what is being done now, thus supporting people-centred rural development; protecting the environment at the same time.

Agriculture is the sector that employs the most significant number of people worldwide, providing livelihoods for 40% of the world's population. It is the primary source of income and employment for the poorest rural families.

One of the goals of the Agenda for Sustainable Development (Agenda 2030) adopted by the UN is to end hunger, achieve food security, improve nutrition and promote sustainable agriculture. Sustainable agriculture refers to the type of production that meets and protects the needs of present and future generations while ensuring profitability, environmental health and social and economic equity.

The objectives of sustainable agriculture are:

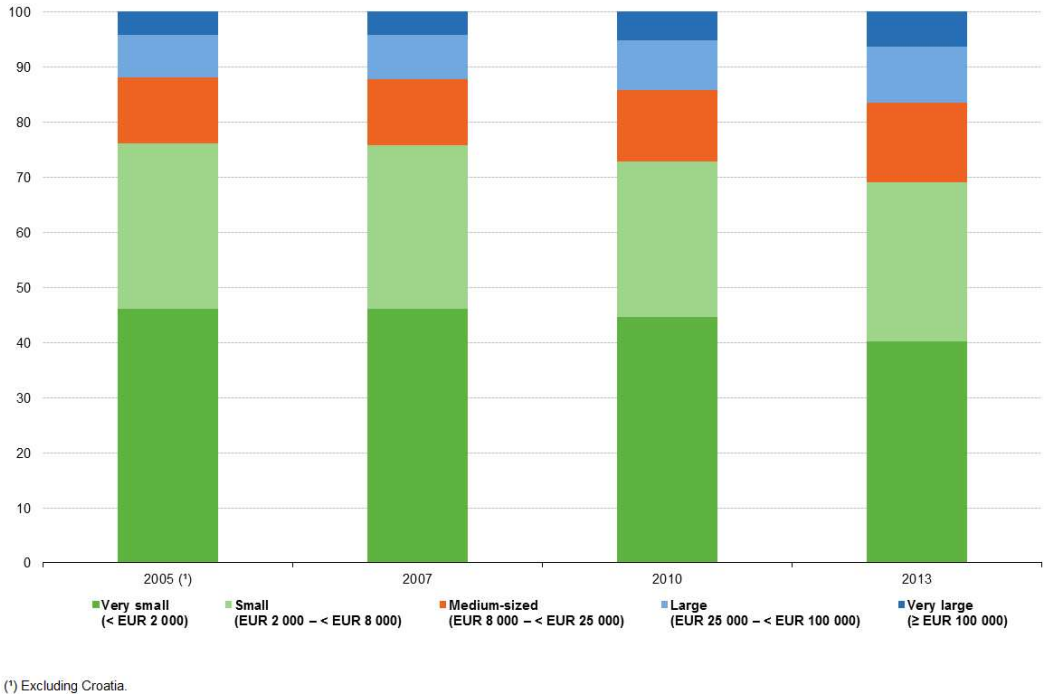
- To favour techniques that safeguard nature, preserve soil fertility, prevent water pollution and protect biodiversity;
- Use up to 56% less energy per unit of crop produced;
- Create 64% less greenhouse gas emissions per hectare and support higher levels of biodiversity than conventional agriculture.

CHAPTER III – The importance of the network for dissemination

Because of the urgency to take timely action and the importance of the primary sector in the current environmental situation, we will see how behavioural change studies can help accelerate the necessary change. In addition, the organisation of the European primary sector; in Europe, farming contexts are numerous but are often, as we have seen, organised in individual or family societies. Family farming is the predominant form of primary activity in Europe. FAO (2015) estimates that there are 500 million active family farms in all over the world. They represent more than 90% of farms and produce more than 80% of food in terms of economic value. They, therefore, play a central role in the food security of present and future generations.

Even when studying the situation of farms in Europe economically, it can be seen that small sizes prevail, albeit with exceptions in the upper-middle range (Figure 11).

Figure 11 - Share of the total number of farm holdings by the economic size of the farm, EU-28, 2005



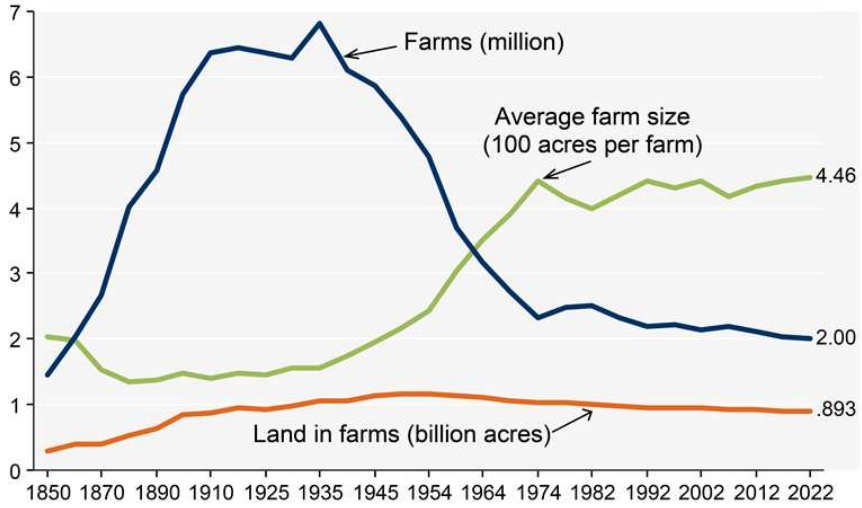
(¹) Excluding Croatia.

(Source: Eurostat, statistics from the farm structure survey, 2018)

In the U.S.A., the size of land and farms has also changed, but in a different way than in Europe, where, although small farms are prevalent, there has been an increase in hectares over the years. While overseas, where farms have always been characterised by their large size, there has been a reduction over the years, both in the number of farms and in size. In the latest survey by the Economic Research Service of the U.S. Department of Agriculture, there were 2.00 million US farms in 2022, down from 2.20 million in 2007. Likewise, farm acres continued to decline, with

893 million acres in 2022, down from 915 million acres ten years earlier. The average farm size was 446 acres in 2022, slightly higher than the 440 acres recorded in the early 1970s.

Figure 12 - Farms, land in farms, and average acres per farm, 1850-2022

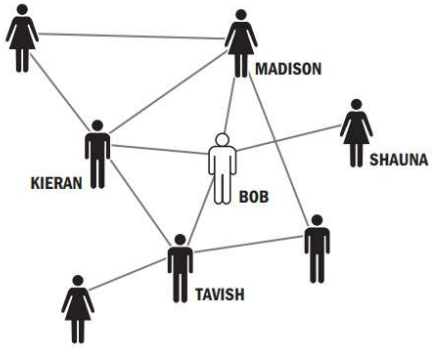


(Source: USDA, Economic Research using data from USDA, National Agricultural Statistics Service, Census of Agriculture (through 2017) and Farms and Land in Farms: 2022 Summary, 2023)

3.1 The network at the basis of all interactions

This sub-chapter will explain how crucial the connections a person makes throughout life are in many ways. Other people influence people, their behaviour and ways of thinking. We live in societies in which it is mostly not possible to live without meeting other people, so it must be realised that living in the community does not allow our research, as in many others, to overlook the fact that an individual is an integral part of a world that surrounds and influences him. As Centola has proven in his numerous studies, some bonds are created that unite the community.

Figure 13 - Friends of friend's network



(Source: "How behaviour spreads", Damon Centola)

Figure 13 shows us a graphic representation of a network; at the centre, there is the individual in analysis, Bob, every line connected to him is his link, and other lines then start from his links

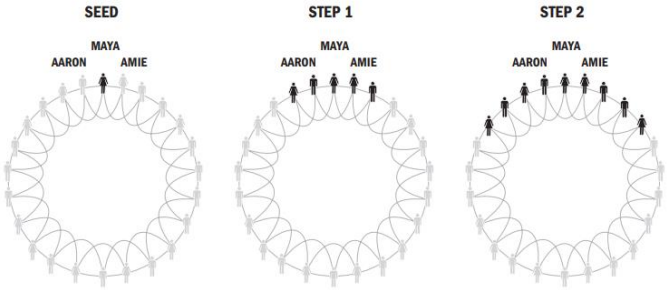
which will have additional links. Two connected individuals often have many connections in common; this creates difficulties in dissemination because resources are wasted on dissemination, and information becomes redundant. However, in one case, this redundancy facilitates dissemination: complex contagion needs confirmation to be spread. There is, therefore, a need for several individuals to confirm the same information. There needs to be more than understanding Bob's beliefs and behaviour to know to whom he is connected. It is also essential to know who his friends are connected to. We discovered that Bob has four friends: Kieran, Madison, Shauna and Tavish. The structural diagram depicts in graphic form that Madison and Kieran can pressure Bob to conform to their shared behaviours. In turn, Kieran and Bob can coordinate to pressure Tavish. On the other hand, Shauna is not subject to the same social pressures as Bob's other friends and can therefore be considered a weak link in Bob's social network.

Consequently, the bond between Bob and Shauna can serve as a valuable conduit for new ideas, information and behaviour in Bob's neighbourhood because she can bring in ideas, news, and behaviour without being influenced by Bob's social network. In the case of strong ties, the environment often does not stimulate the emergence of innovations; this is because everyone conforms to the ideas of others, which are heard and repeated. One wants to follow a shared vision. Furthermore, seeing the same people and the same environment does not inspire the birth of new ideas. On the other hand, weak ties bring a breath of fresh air, bring novelty and stimulate the birth and growth of innovation. Weak links stay out of the tangle of relationships in which the person at the centre finds himself.

Figure 13 depicts the distinction between weak and strong ties. Between Bob and Shauna, there is a weak bond; this can be said to be due to Shauna's lack of ties with the rest of Bob's friends: strong ties tend to bring together acquaintances who know each other and, in turn, establish a bond. On the contrary, Bob has strong ties with other subjects, where there is more influence and less possibility to introduce 'newness'. Strongly connected issues tend to have very similar ideas, primarily if they have known each other for a long time. They are used to being in the same environment and associating with the same people and therefore have no incentive to go against the current. Therefore, there is less chance of new ideas coming from solid ties.

Weak ties bring together acquaintances who interact less frequently and are less invested in the relationship. Strong ties connect close friends or relatives whose interactions are often affectively charged and highly salient to each other.

Figure 14 - Diffusion in a clustered network



(Source: “How behaviour spreads”, Damon Centola)

There are advantages and disadvantages to both types of bonds. The strong link has the decisive advantage of the source’s reliability, but at the same time, it risks creating redundancies in communicating the same message. In this respect, it is possible to take the example of Maya, who is looking for a person to hire and therefore has the objective of disseminating her job advertisement. In step one of this dissemination process, shown in the middle panel, Maya activates her four immediate contacts, shown in black. The problem arises as soon as Maya's contacts hear about the job again; as Maya's connections are strong, they, in turn, also have a relationship, creating an intertwined triangle. For example, we can see how in Phase 1, Maya informed Aaron and Amie of the job offer; then, in Phase 2, they spread the information to their neighbours. But since Aaron and Amie are connected in phase 2, they send each other redundant messages. Signals that should go to new people are wasted on going to people who already know of the job. In Granovetter's words, “What needs to be disseminated can reach a greater number of people and cross a greater social distance if it passes through weak rather than strong ties”.

There is, however, one particular case in which information redundancy brings benefits: complex contagion. For Centola (2021), complex contagion is a spread of behaviour or ideas through complex social networks, where influence occurs through multiple interpersonal interactions and not only through direct contact between individuals. This means that contagion spreads non-linearly and can be influenced by numerous factors, such as social position, diversity of opinions and the strength of connections between people within the social network. Centola argues that understanding these factors is essential for designing effective strategies for influencing and changing social norms.

A situation in which the power of relationships is amplified is where there is a cluster. Agricultural clusters are organisations of companies and other public and private actors working in synergy to improve the efficiency and competitiveness of agriculture. These clusters include

all agri-food activities, from harvesting to processing and marketing of products. Agricultural clusters can help increase agricultural productivity by sharing knowledge, innovations and technologies. They can also promote environmental sustainability and foster rural development. In addition, agrarian clusters can help agriculture improve its competitiveness by creating collaborative networks and exchanging skills and knowledge between enterprises, thus facilitating access to new markets and distribution channels. In addition, agricultural clusters can support income and job creation in rural areas, promoting local communities' economic and social development. Clusters help companies to collaborate with other entities. In Italy, an association promotes networking and enables companies, trade associations, universities, research organisations, training bodies and territorial representatives operating in the Agrifood sector to work together to help each other and innovate. This association recognised by the MIUR (from 2019) is called Cluster Agrifood Nazionale (CL.A.N.). Other objectives are to defend and increase the development of the agrifood supply chain from agricultural production to processing and related industrial sectors; this is done through the stimulation of innovation, the valorisation of research results, the creation of new competencies, and the collaboration between research, companies, institutions and public administration. It represents a unique interlocutor in the relationship with national and European institutions on research and innovation for the agri-food sector. Since only a few works in the industry, between companies, they get to know each other personally, which can be used to pass on information or train in new techniques. There may be a fear of competition, but if there is an interchange of information, these connections benefit both parties. By exploiting strong links or the redundancy of information, those sceptical about innovative techniques can be persuaded to try and adopt them. As technical choices can be passed on, disseminating eco-friendly work behaviours would be even more helpful. Often these behaviours are seen as a cost, so it would be necessary for companies that have already made them part of their culture to convey to others in the industry that it is an investment.

Considering the way a movement spreads, such as that for environmental protection, for example. When a social movement expands from initial activists to recruits, each wave of participants becomes the first line of new recruiters.

3.2 Social mechanisms behind a decision

When exposed to a new behaviour or idea, you decide whether to accept or reject it. And this response is not automatic; the decision can often be complex and emotional. Researchers have

shown that when considering whether or not to adopt a new belief or behaviour, we are influenced more than we realise by our social network[12].

The people who, through the relationships established, influence us also have the power to condition our choice to adopt an innovation. The complex contagion is represented by the mentioned situation, where the parties have a relationship. One can help the other convince himself to make a particular choice. Increasingly, this mechanism is being considered by companies and politicians to improve sales techniques and approaches to people. A deliberate effort must be made if a person wants to adopt a new conversational style/handshake. Sociologists have analysed the case of Aerosmith's gesture in Second Life: The value of the motion, like most goods in Second Life, depends on whether other people commonly accept it. If one is accustomed to greeting people within a group in a certain way, before changing the method, one prefers to be aware that many will accept and share the gesture. For example, in a situation where it is customary to shake hands, it would be strange if, one day, one person were to start hugging everyone, thus replacing the handshake. Once a new social trend takes hold, it is good to be on the frontier. Sociologists call this: a credibility problem. Based on other people's behaviour, you change or not the social gesture you adopt. But how many people must assume the same motion before the trend can be considered popular enough to embrace it? We will see later that it depends on one's social network size.

Two decades ago, the work of Katz and Lazarsfeld suggested that highly connected influencers were the key to spreading everything from social movements to innovative technologies. Like Katz and Lazarsfeld, Gladwell theorised that social change depends on a few people and called this phenomenon "the law of the few": a small number of social stars whose efforts are responsible for spreading new ideas/behaviours to the rest of the people. But this was later refuted through several studies, one among them that of renowned German sociologist Karl-Dieter Opp on the case of the Berlin Wall. In the fall of 1989, the Soviet Union was on the brink of crisis; its end was coming. Every day East Germans gathered along the vast wall that separated them from the free West, clashing with Soviet police pointing loaded machine guns at the crowds. In the weeks after the fall of the Wall, the German sociologist, Karl-Dieter Opp, was conducting the most advanced scientific investigation of the social turmoil of that era. After driving many miles, he arrived at the starting point of the protests, Leipzig, and began

[12] Social networks have always existed, which is precisely why we refer not only to digital ones, but especially to physical ones. They include everyone with whom we interact, work, compare, meet, everything that is part of our social world.

interviewing people he met. The sociologist asked people why they were there despite the threat of being killed or imprisoned. They answered that they were there because their friends and family members were. Cohesion had been created among strong ties to support and motivate each other. This can thus be described as a collective process of social coordination.

People living together in today's societies influence each other. This influence often leads to support in situations where joining forces leads to more and better results. A key element is coordination. It may sometimes be spontaneous; sometimes, it results from common expectations based on existing norms. Automatic coordination, which I assume is hardly ever found in the field of climate change, was demonstrated by a professor at the Hebrew University in Jerusalem. The professor held an annual course every Sunday at noon. Sixteen students were enrolled, and the professor promised that if, at each lecture, there was a minimum number of 11 students present in class, they would all get a final grade of 86. Any course with less than 11 in attendance had the consequence of lowering the grade for everyone, regardless of who was present. Surprisingly, at least 12 students always turned up for each lesson without agreeing to take turns or booking their attendance to do the counting among themselves. This real-life episode is an example of an automatic mechanism for coordination and cooperation without norms dictating how to behave to reach the goal. (Bicchieri, 1993)

3.2.1 Economic incentives

The independent actions of individuals can produce an order that was not intended; automatic mechanisms of coordination and cooperation arise, and self-interest is a key element. Most individuals act based on what is best for themselves, not caring how the result of their actions affects society. Sometimes, however, these selfish actions coincide with an ideal outcome for the community. When this is not the case, however, care should be taken to steer the selfish decision in a direction favourable to the common welfare. The best method is to incentivise the individual by focusing on their values or interests, one of the best methods is the economic incentive.

For decades, economists have extolled the advantages of approaches to environmental protection based on economic incentives. A century ago, Arthur Cecil Pigou (1920) suggested applying corrective taxes to discourage activities that generate environmental pollution. Hanh and Stavins (1992) report that:

> *"In the economist's version of public policy heaven, the objectives for the policy will typically be efficiency (maximising net benefits) or cost-effectiveness (choosing the least costly method for achieving a goal). Efficiency and cost-effectiveness,*

however, are by no means the only possible criteria for judging environmental policies. Other considerations might include overall effectiveness, ease of implementation, equity, information requirements, monitoring and enforcement capability, political feasibility, and clarity to the general public."

Environmental goods, free or cheap, are overused, causing damage that is difficult to contain. Economic incentives solve this problem: they price environmental damage or create property rights on ecological goods. It is not always easy to put a figure on this, partly because some expenses do not reflect the actual value of what is obtained; for example, products such as fish, timber and minerals are not also attributed to the cost of environmental damage resulting from extraction and processing. On the other hand, other resources, public or social, do not have a price. This is precisely why individuals are most likely to damage them: the atmosphere, waterways, and forests are examples.

The market does not consider the consequences companies cause when they dispose of polluting discharges into a watercourse. In addition to causing harm to the fishermen in the area, the populations at large are also affected. And this is not reflected in company accounts; these spillover effects are called externalities and represent the failure of the market to protect the environment. Economists levy taxes to compensate for this market failure; the state imposes tariffs on coal companies to reinvest the money in health care to treat miners with lung diseases, for example, while these taxes also incentivise the company to find more sustainable production methods. The regulation has an alternative; it can ensure that the company internalises pollution costs, forcing it, for example, to take polluted water downstream at its own expense (Beder, 2001)

Some of the measures that governments can take to avoid more significant negative consequences from business activities are **environmental taxes** (as early mentioned), **environmental subsidies** (environmental subsidies can incentivise adopting environmentally friendly behaviour), **tax benefits** and **recycling programmes.**

Economically incentivised policies can steer individuals' decisions towards environmentally friendly behaviour. These encourage environmentally friendly behaviour and enable society to create a sustainable future.

In our analysis sector, governments must direct their choices so that these incentives and regulations are adapted to the activities of farms.

1. In this way, governments can **promote sustainable farming practices** such as crop rotation, integrated pest management, and reduced chemical fertilisers and pesticide use.

This can help reduce the negative impacts of intensive livestock production on the environment and prevent soil degradation, water pollution, and biodiversity loss.

2. Another government practice that should be imposed on companies is **to draw up management plans** to protect sensitive natural areas, reduce erosion, and incentivise farmers to use sustainable practices, making them accountable for the effects of their actions.
3. Regulations can help to protect human health, wildlife and the environment from exposure to harmful chemicals; it is possible to **ban or force a reduction in the use of chemical pesticides** that are a health hazard.
4. Economic incentives, reduced taxes, subsidies and, in addition, **low interest on loans** can also be arranged for farms. The low-interest technique allows companies to invest in more environmentally friendly tools, such as less polluting machinery and more sustainable products. Furthermore, with more economic possibilities, they can adapt their plants to dispose of polluting waste more sustainably.
5. Governments can also establish environmental **protection agencies** to monitor and regulate farms to ensure they comply with environmental regulations. Meanwhile, these agencies can offer support and knowledge to farms that ask for them. The function of support and education is fundamental; if governments provide education about environmental protection, farmers are more propensity to understand the need for sustainable farming practices.

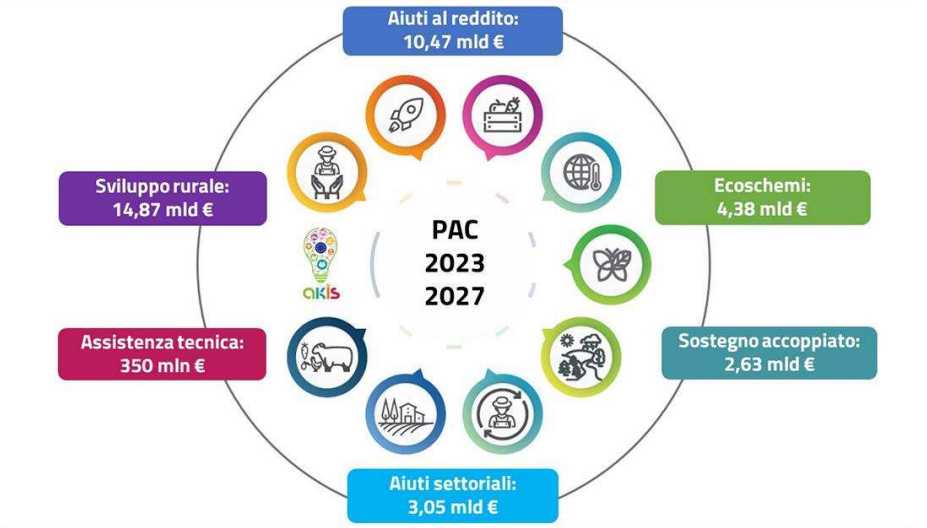
Sustainability allows you to increase your corporate value; by integrating greener choices and behaviour into your strategy, you can reduce costs and waste, thereby increasing the efficiency of your business activities and processes. In European Union and, in particular, in Italy, there are incentives that the government provides to encourage companies to incentivise farms to respect the environment. Some examples include:

1) **CAP (Common Agricultural Policy):** the government provides funding and support to farms that adopt sustainable practices to protect the environment and biodiversity.

   The objective of the Strategic Plan for implementing the CAP 2023-27 submitted by Italy to the European Commission is to strengthen a strategic sector such as agribusiness and forestry, ensuring environmental, economic and social sustainability. The Plan was drafted based on the provisions of Regulation (EU) No 2115/2021 and brings together resources and interventions for the first time in a single programming document to support farmers' incomes, improve market conditions for certain agricultural products, and foster rural development. The interventions, under the responsibility of the Ministry, the Regions and

the Autonomous Provinces, are integrated. The resources allocated to the various interventions amount to almost 27 billion euro of EU resources, plus about 9 billion euro of national and regional co-financing for rural development interventions.

Figure 15 - CAP National Strategic Plan 2023-2027: an overview of interventions and estimated financial envelope by type of intervention



(Source: http://www.pianetapsr.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/2668)

Total budget is equal to €35.6 billion:

- Rural development (€14.87 billion): Environmental and climate and other management commitments, natural or other specific territorial constraints, specific territorial handicaps resulting from certain mandatory requirements, investments (including those in irrigation), risk management tools, cooperation and knowledge exchange and information dissemination.
- Income support (€10.47 billion): Basic income support for sustainability, complementary redistributive income support for sustainability and complementary income support for young farmers.
- Eco-schemes (€4.38 billion): Animal welfare and reduction of antibiotics, grassing of tree crops, olive trees of exceptional landscape value, extensive forage systems and specific measures for pollinators.
- Coupled support (€2.63 billion): Animal husbandry, surface and protein crops.
- Sectoral support (€3.05 billion)
- Technical assistance (€350 billion)

The CAP also includes the Rural Development Programme, which provides funding for projects promoting organic farming, using renewable energy sources, and fighting against desertification.

2) It is essential to emphasise the function of the tools required to analyse, assess and communicate the environmental performance of products and organisations. Since the end of the last century, the European Commission, member states, and various international organisations have developed **environmental certification tools**. These tools can be summarised as follows:
   a) Environmental management systems (such as EMAS)
   b) Environmental labels (ISO Type I, governed by ISO 14024, e.g. EU Eco-label)
   c) Environmental self-declarations (ISO Type II, governed by ISO 14021, e.g. Mobius loop)
   d) Environmental Product Declarations (ISO Type III, governed by ISO 14025)
   e) Mandatory marks and labelling (e.g. energy-saving labelling)

   These tools, in particular, the type I and III labels, have as their core the life cycle analysis of products (LCA), which makes it possible to identify each phase of the cycle (from the sourcing and processing of the materials necessary for their production to their final disposal), the most significant environmental impacts, thus allowing the definition of improvement objectives and standards to be achieved. In recent years, the European Commission has deemed it necessary to take action to try to "standardise" the various tools concerning products to make them easier for consumers to use and to make it easier to compare the results of analyses (LCA): on the one hand, it has defined a standard for the construction of a European LCA "Life cycle data network" database, and on the other, it has launched the "Environmental footprint" programme. The Ministry of the Environment, as we have seen, pays particular attention to the implementation of policies aimed at improving the environmental performance of products and production cycles with the classic instruments of 'command and control', as well as with the promotion of voluntary agencies such as those relating to environmental certification.

3) Agricultural companies are favoured by the **incentives and tax regime** provided for income from farming. An agricultural company provides for taxation on land income on a cadastral basis: the agrarian and dominical income established for that land according to its location is taken into account, which is taken as taxable income. Suppose the person conducting the agricultural activity meets several requirements to be classified as a professional agrarian entrepreneur (IAP status). In that case, he will also benefit from taxation on a percentage basis of the land income.

The preferential regime for determining income according to the cadastral criterion applies to partnerships (snc, sas), srl, and cooperative societies, which qualify as agricultural companies. There are, at the same time, requirements to be met:

a) They must have as their corporate purpose the exclusive exercise of the activities set out in Article 2135 of the Civil Code (cultivation of the land, forestry, animal husbandry and related activities);
b) They must have the words 'agricultural company' in the company name (in the case of partnerships) or company name (in the case of corporations).

An experiment was carried out in which the impact of financial solutions on the agricultural activity of 198 Mali communities in the Sikasso region was studied. Eighty-eight villages were offered the possibility of accepting loans specifically for agriculture. In contrast, some households in the remaining towns and those who had taken the loans were given fixed-value subsidies, specified to be one-off (not to discourage those who would want a loan in the future). The loans were marketed, implemented, serviced and financed by Soro Yiriwaso, a Malian microcredit organisation (and an affiliate of Save the Children, an international non-governmental organisation based in the United States). The cash grants were implemented by Innovations for Poverty Action. The peculiarity of these loans lies in the fact that they respect the financial timing of farming. In contrast, companies that usually lend to the local poor start demanding frequent payments after a short time, this type of loan began to be repaid after the harvest period had passed. In this way, households that agreed to borrow money to make investments had time to wait for these to bear fruit, at least a part, in the short term.

Administratively the loan is given to groups of women organised into village associations. Still, each woman receives a contract with the association because to accept the loan, a woman in the family has to join the association. Although the woman owned the loan, the whole family could benefit.

As for the grant, the modality was similar: In the 110 villages not offered loans, households were randomly selected to receive gifts and a female household member – to parallel the loans - was always the direct recipient. The amount was high ($140), covering more than 70% of the average input costs ($196); that amount was chosen to make the proposed loan amount fair. It was noted that those who accepted to borrow the sum of money had characteristics in common: high investment in agricultural activity, sound output and profits, and higher farming assets and livestock; furthermore, the women who took responsibility for the loan were more integrated

into society and had decision-making power within the family in comparison with those who did not accept the loan.

In the analysis of the results Beaman et al. (2014) show the results on agriculture.

Data from households in no-loan villages who did receive a grant compared to those who did not:

- The amount of land cultivated increased (0.175 ha, se=0.065), a small but significant amount,
- The grant also increased hired labour days (2.7 days, se=0.80),
- Fertilizer ($11.07, se=4.38) and other chemical inputs ($9.02, se=2.2),
- Total input expenses (excluding family labour and land value) increased ($28.26, se=8.23).

The grants, therefore, led to an increase in agricultural investment.

The output and farm profits (excluding the value of family labour and land) went up significantly, respectively, by 13 per cent ($66, se=19.05) output and by 12 per cent ($40.25, se=15.35) profits. Overall, it is possible to see significant increases in investments and profits from relaxing capital constraints.

While households in no-loan villages increased the amount of land cultivated as a result of the grant (0.175 ha, se=0.065), by contrast, farmers in loan villages, who did not take out a loan, did not increased the amount of land cultivated (-0.16 ha, se=0.09).

The interaction term for family labor days (-8.9, se=6.4), fertilizer expenses (-$8.8, se=6.5) and other chemical expenses (-$7, se=3) are all negative, though only the latter is statistically significant.

For the households who refused the loan, the grant induced some increase in inputs (by $17, which is not statistically different from the estimate in no-loan villages of $28). Still, there was no evidence of increased agricultural output or profits simultaneously, in stark contrast to the random sample of households in 110 villages without loans.

In the second year, it is possible to observe that in no-loan villages, there are still benefits from the previous year for those who obtained the subsidy. Outputs and profits remain positive despite total input expenditure not increasing by much.

Regarding loans, which had an average size of $113, there were good results, albeit lower than those of the grant farmers in the no-loan villages. Cultivated land increased (0.094, se=0.058),

as did family labour (8.66, se=4.83) and expenses (fertilizer $10.35, other chemicals $5.08, total input $21.86). This trend is also maintained by the value output and profits of those who accepted the loan, which are $32.26, se=19.46 and $17.05, se=15.80 respectively.

Table 1 - Effects of grants and loans on other outcomes than agriculture over time

	Own any livestock	Total value of livestock	HH has a business	Food consumption EQ (past 7 days)	Monthly non-food exp	HH has any financial savings	Primary is member of ROSCA	Educ expenses	Medical expenses
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A. Grant recipients, Size of grant: $140									
Grant * year 1	0.114 ***	158.06 **	0.038 **	0.38 ***	2.95 **	0.024	0.017	2.24	-2.54
	(0.014)	(72.15)	(0.015)	(0.11)	(1.40)	(0.016)	(0.015)	(3.03)	(1.85)
Grant * loan village * year 1	-0.046 **	-42.31	-0.007	-0.08	1.02	0.023	-0.010	-1.72	4.37 *
	(0.022)	(109.33)	(0.022)	(0.17)	(2.03)	(0.029)	(0.023)	(5.27)	(2.52)
Grant * year 2	0.092 ***	270.05 **	0.030 **	0.05	3.89 *	0.035 *	0.039 **	0.41	-0.76
	(0.015)	(132.50)	(0.013)	(0.17)	(2.12)	(0.019)	(0.018)	(3.64)	(1.80)
Grant * loan village * year 2	0.000	-275.21	-0.025	0.35	-1.54	0.034	-0.016	0.07	1.02
	(0.023)	(177.89)	(0.020)	(0.23)	(2.76)	(0.026)	(0.025)	(5.00)	(2.72)
Grant + Grant * loan village = 0 (year 1)	0.000	0.161	0.065	0.015	0.007	0.053	0.687	0.903	0.284
Grant + Grant * loan village = 0 (year 2)	0.000	0.965	0.750	0.015	0.182	0.000	0.180	0.887	0.900
N	10846	10793	10848	10748	10434	10727	10727	7500	10752
Mean of control (year 1)	0.780	1237.69	0.828	3.25	43.56	0.636	0.250	71.49	31.56
SD (year 1)	0.414	2096.50	0.377	3.26	36.89	0.481	0.433	81.73	44.79
Panel B. Loan ITT, Average loan size: $113									
Loan village - year 1	0.010	168.08 *	-0.007	0.10	0.20	0.019	-0.011	4.35	-4.78 ***
	(0.014)	(88.53)	(0.023)	(0.13)	(2.11)	(0.024)	(0.024)	(3.95)	(1.62)
Loan Village - year 2	-0.008	48.33	0.002	0.07	-0.45	0.004	-0.016	3.36	-0.78
	(0.017)	(111.44)	(0.015)	(0.17)	(2.49)	(0.027)	(0.026)	(3.47)	(1.81)
N	8634	8634	8634	8566	8291	8533	8533	6050	8539
Mean of control (year 1)	0.777	1341.16	0.833	3.19	44.28	0.635	0.263	69.87	33.26
SD (year 1)	0.417	2479.04	0.373	3.20	38.27	0.482	0.440	81.20	44.98

(Source: Self-Selection into Credit Markets: Evidence from Agriculture in Mali, Beaman et al., 2014)

In table 1, Beaman analysed the outcome other than agriculture: It came out that grant-recipient households in no-loan villages are more likely to own livestock (0.11 percentage points, se=0.014), and there is a large ($160, se=72) increase in the value of total livestock compared to no-grant households. The livestock value is measured several months after harvest; these results may indicate that households moved some of their additional farming profits into livestock post-harvest. There is also evidence that the grant recipient households also consumed more, $0.38 per day in adult equivalency and $2.95 per month.

This study revealed that capital constraints put the population in southern Mali in a problematic situation. Several microcredit companies try to help local folks with credit. Still, often the benefits of this commitment are not enjoyed to the fullest because people have to start paying their debts again immediately. In Mali, for example, Soro Yiriwaso is the only microcredit organisation with a product specially designed for agriculture; the company allows families to start paying back the loaned amount after the harvest. This flexibility and adaptability of the credit business enable people to feel free of cash and to invest their money in the best possible way, thus achieving better results.

Those who accept the loan also have higher marginal returns, so there is a self-selection for credit in communities. Another significant result was the evaluation of the impact of subsidies on the community, which had even better effects than loans. These led to higher input investments, outputs and profits, not only in the same year but also in the following year. These results, therefore, prove that any tool introduced into a community to improve it must be adapted to that environment and the activity's objective.

3.2.2 Education

The lack of education and knowledge about the climate risks we are experiencing is one of the leading causes of the current climate crisis; many people need to be made aware of the gravity of the situation or the role that each of us plays in perpetuating climate change. Another thing that hinders the correct spread of information on these issues is the presence of widespread misinformation by some lobbies that deny the existence of climate change and man as the main responsible. The general ignorance of the subject is noted by the little attention and underestimation their daily actions have on the environment. They do not understand the need to reduce CO_2 emissions, use clean energy sources, or use disposable plastics, and they do not understand pollution.

Regarding the primary sector, workers must be educated on respecting the environment and incentivising them to devise and apply innovative and sustainable solutions. It is important to train those who work in agricultural enterprises on the solutions introduced in the market to safeguard the environment and new methods of agricultural production and animal husbandry; it is also essential that workers in the primary sector are informed about the consequences of deforestation, greenhouse gas emissions and alterations in the water cycle on food production and the natural environment. However, workers are not the only ones who need to be educated; consumers also need to be aware of the purchases they make and the consequences their actions have. Educational initiatives should also include consumer awareness programmes on the benefits of sustainable and ecological agricultural and livestock products. Furthermore, for more effective communication policies on this topic, information and knowledge sharing between primary sector workers, scientific researchers, and institutions should be aimed. This can be done by promoting synergies between universities, governments, NGOs and private companies, focusing on innovation and experimentation of new sustainable techniques in the primary sector.

Present and future impacts to address this climate crisis, education and knowledge about the risks of climate change must become an integral part of educational programmes at all levels, from elementary to university. To make the younger generation understand the importance of

the primary sector, it is essential to let them experience the environment first-hand: whenever possible, it is helpful for the school to create a space in the garden for the students to take care of it. Since many children need to consume more fruit and vegetables daily, seeing the food grow with their care could invite the students to appreciate it more. In general, to safeguard the planet, first steps can be taken at all school levels, some examples of which are listed below, and then when the students have a base of information, one could focus on actions to promote and encourage knowledge and safeguard the primary sector. The teachers could instruct younger children to reuse the sheets to draw or use them as placemats for eating, making envelopes, etc. For children in elementary school, it could be helpful to take walks in nature, highlight its beauty, explaining the respect for the environment. Lessons and workshops can be dedicated to educating children on how to make the separate collection, a habit they can bring to the family. Older children can be shown the consequences of climate change and the effects they will have in the coming years, and you can develop strategies that each of them can implement to make their contribution to the management of this issue. They can be made of paper recycling workshops or have them work with younger children to work with waste fabrics. Encouraging student-led projects is substantial; teachers can encourage students to lead climate change projects, such as setting up a recycling program, creating a school garden, or conducting a citizen science project. This approach can help students become active environmentalists and reinforce the concepts they have learned in class. University students, being close to the world of work and gaining more knowledge, could implement ecological strategies in the companies where they will be hired. Some may also become so passionate about these issues that they become researchers and discover new theories and methods to help save planet Earth. All these little gestures, and potential theoretical and practical lessons, would help change the behaviour of the individual and those around them. If everyone acquires eco-friendly habits and implements them automatically and continuously, the behaviour will slowly spread throughout the surrounding network. By focusing on education, the new generations will be better equipped to face the present and future more sustainably.

There are two main strategies regarding environmental education: focusing on meaningful information and engaging teaching methods. Some studies (Wise, 2012) have noted that parents often do not argue that a teacher doing environmental education is doing their job well. In this way, educators fear losing credibility and effectiveness (Morris et al., 2014; Tyson, 2014). Other educators, however, claim they need to gain the skills and knowledge necessary to adequately provide instruction on climate change (Monroe, Oxarart, and Plate 2013; Plutzer et al. 2016; Prokopy et al. 2015). The best methods to convey the necessary values for respect for the environment and the essential knowledge are based on allowing students to create their

understandings and develop new skills through active learning opportunities and survey-based practices (NAAEE 2004). Educators, working with students in this way, have the opportunity to stimulate them: new actions are born from their ideas, collaborate and coordinate, work with images, data and models, and finally, they understand why time is devoted to that lesson and why it is essential. Some alternative and practical methods may be field trips, flipped classrooms, simulations, worksheets, data collection, role-playing games and community action projects (Monroe et al., 2019). Very instructive could be trips to farms to convey the importance of respecting nature and animals. To increase that sensitivity that tends to diminish with age, we need to respect living beings, nature and thus the entire planet Earth. An element to focus on when educating about environmental respect, in addition to the involvement of the individual, is personal relevance so that students feel involved and part of the topic; by doing this, they can connect what they already know with new material, establishing in their interest and meaning to participate (Kaplan and Kaplan 1982). Educators must pay attention to some aspects of climate change: such as the lack of direct and visible culprits, the remoteness of impacts and the delays in time between emissions and effects on the climate system, because these motivations may risk compromising the commitment to making their lectures personally relevant (Dilling and Moser 2007).

Given the point at which we arrived, it is evident that the methods used until now need to be revised for our world's needs. Structures supporting the importance of an excellent environmental culture must set a good example, starting with schools and reaching governments.

3.2.3 Elements that help to change behaviours

Social psychology has long studied the role of social mechanisms in individual decision-making. Indeed, a person's opinions and behaviour can often be strongly influenced by the group to which they belong or by which they feel stimulated. This section will explore some of the best-known features of social influence processes and analyse how these can condition individual choices. These include strategic complementarity, credibility, legitimacy, and emotional contagion. (Centola, 2018)

Strategic complementarity/Coordination: the value of behaviour increases with the number of others who adopt it. In ‘network effects’ situations, the economic value of choice may depend on how many others have made the same choice. The classic example is communication technology: fax technology needs at least more than one device in circulation. The greater the number of fax machines, the greater the propensity to buy one. One person alone cannot convince the user that it is worth spending so much capital; however, as more contacts own a

device, its relative value increases. The more people adopt, the more valuable the innovation becomes and the easier it is to spread.

Credibility: the more people adopt a behaviour, the more credible it is that it is beneficial or worth spending 'the cost of adoption'. The propensity to innovate increases when known people adopt the technology or behaviour. For example, James Coleman found that doctors were only willing to adopt medical innovations once they saw them used by their colleagues. Repeated confirmation by trusted others overcomes the credibility barrier.

Legitimacy: the more people adopt a behaviour, the higher the expectation that others will approve of the adoption decision and the lower the risk of embarrassment or sanction. Battles are being waged on many 'sensitive' issues nowadays to normalise matters. An example can be seen in the debates for the rights of people who identify themselves by the acronym LGBTQ+; by increasing the resonance of the topic and giving them more rights, information spreads, and as a result, people feel more accepted by society to express themselves. Social reinforcement from respected peers overcomes the legitimacy barrier.

Emotional contagion: the emotion associated with adopting a behaviour increases with the number of others who embrace it. Diffusion can first be studied on a cluster network and then observed when long ties are introduced. In the practical context, let us take the example of a football stadium and make two separate cases. In the first case, when a team scores a goal, only one team fan cheers for the purpose. In the second case, the whole corner celebrates and sings to express happiness. The emotion of the fan cheering alone is not comparable to what he may feel in the case of the cheering of the whole curve of that team. Social reinforcement among energised peers is essential for these emotional contagions to spread.

All these characteristics justify the complexity of transmitting information or behaviour through various links. The kind of dissemination also changes according to the message type; if an effective method is found to disseminate a job offer announcement, the same methodology may not necessarily apply to a different kind of request, such as the sale of a product. Each message category has an appropriate communication structure to be identified and used. In addition, the key to real social change is to create entrenchment. Centola's (2021) studies show that the product can be anyone, a free life-saving HIV drug or an expensive new gadget; people's resistance to change is often just a signal of their search for social validation. Once resistance is understood, it is no longer seen as an obstacle to change but as an opportunity for a connection. The greater the sense of belonging to the group, the broader the radius of influence

of the above-mentioned social mechanisms. A great example of how social reinforcement in a group is essential, even in environmental actions, will be seen below.

It happened in the 1990s when several European countries pushed for a shift to solar energy. Switzerland, Germany, Italy, and other European countries took the first legislative steps. They thought about how to incentivise citizens to adopt and tried the economic solution, giving financial incentives to adopters. This solution failed, however, in both Switzerland and Germany, despite publicity campaigns and support for the initiative; after an initial wave of adopters, the phenomenon did not spread. It turned out that for people, financial support for adopting renewable energy was not enough; they needed social reinforcement. Once neighbours, friends, and family would adopt the technology, they too would do so. This last example also shows the importance of social support regarding changing attitudes towards environmental protection.

3.3 Trendsetter strategy

Influencing and being influenced by one's group is familiar to many people. Still, some individuals can stand out and go against the current. These individuals, known as trendsetters, are those who first begin to create trends and lifestyles that differ from the rest of the group. Their ability to act independently and go against predefined canons makes them exciting and unique. However, despite their ability to step outside the herd, trendsetters cannot be considered excluded from the social sphere in which they operate. In fact, in many cases, trendsetters are adopted and followed by other individuals who wish to embrace their new ideas and trends. In this way, even trendsetters cannot be considered excluded from the herd but, on the contrary, are an essential part of the culture and society in which we live.

Our world is mainly structured in societies: for change to occur within, someone must deviate. This deviation entails risks and costs for people who make it:

1. Social isolation: The trendsetter may feel marginalised by the group and lose their dominant position.
2. Disapproval from the group: The trendsetter may be criticised or ostracised by the group for breaking social norms.
3. Reduced influence: If the trendsetter has lost the respect of the group, their ability to influence decisions may be reduced.
4. Economic costs: There may be consequences at work if the behaviour change does not align with what the company considers representative of itself.

5. Damaged reputation: The trendsetter may lose the reputation they have built up over time and within the group.

Defined as conformity to ideal models of conduct, social positive deviance presents itself as a social phenomenon that can be seen in two different aspects. On the one hand, there is ethical deviance: that of the extraordinary men, the great creative geniuses, the heroes of altruism, etc. Higher moral values inspire their behaviour and are therefore ethically above ordinary behaviour; society usually recognises them as positive deviants. The prestige they almost always enjoy manifests society's gratitude for their virtuous conduct. But there is also the positive deviance of ordinary people, which is less visible and often needs to be recognised by society.

The positive deviance of ordinary people often results from the desire to define one's identity in opposition to the social context of reference (Paluck and Shepherd, 2012), which is not considered compatible with one's values. As well as positive deviance, there is also negative deviance, those who deviate and violate social or legal norms and have negative sanctions imposed on them.

3.3.1 Norms and Expectations

To better understand the decision of trendsetters to deviate from what current social norms dictate, we need to take a step back and better understand what social norms are, the importance they have and the expectations they form within a society. According to the research of Farrow et al. (2017), what other people do and think matters greatly to individuals, and social norm dynamics can have important implications for societal outcomes (Nyborg et al., 2016).

We must focus on people's expectations to understand how social norms work. Two types, in particular, are of relevance:

a) Empirical expectations concern how others would behave in a given situation.
b) Normative expectations concerning how people think they should behave.

Furthermore, expectations are important because they give meaning to punishment; the threat of punishment only exists if the subject knows that a determined action will trigger a consequence. When one realises that the situation one finds oneself in can be classified as something familiar, rules, often not explicit, come naturally to mind that one must follow. By identifying the situation, we immediately understand what behaviour is appropriate, prohibited or expected within that context. These behaviours emerge spontaneously within our minds because they have been transmitted to us (Bicchieri, 2018). Suppose we try to think of situations in which we happened to enter a place of worship or a library (Aarts and Dijksterhuis, 2003).

In that case, we automatically lower our voices and behave more quietly than we would if we were at a party. The social environment also communicates and enforces, albeit implicitly, beliefs about how to behave in certain situations (Aarts and Dijksterhuis, 2003). Through this social behaviour, situational norms are socially shared and consolidated (Cialdini and Trost, 1998). Therefore, Bicchieri (2018) describes social norms as "the grammar for social interactions". In other words, they are unwritten sequences of behaviour.

What others are expected to do (empirical expectations) and what others expect a person to do (normative expectations) condition a person's individual choice. Norm-regulated behaviour is, therefore, interdependent. If such expectations exist, there is likely to be a social norm underlying that behaviour.

There are many reasons why people can follow social norms: they are effective, they expect reciprocity, they seek social esteem, etc. People follow social standards because they provide a sense of order, structure and predictability to social interactions and help individuals feel a sense of belonging and acceptance within their community or group. Social norms also maintain social harmony and ensure that individuals adhere to acceptable behaviours and values deemed necessary by society. Furthermore, following social norms can lead to rewards such as social approval and a positive self-image, while deviating from these norms can lead to negative consequences such as rejection and social disapproval. People can also follow them for reciprocity; if an individual does not follow a model that he does not consider necessary, he cannot expect others to follow the norms that he considers fundamental. If everyone is diligent and follows the standards, fear of consequences for those who transgress them is more effective. Social norms provide a framework for social behaviour and help individuals navigate their social environment cohesively and functionally. It has also been shown that people tend to underestimate the influence of social norms on their actions (Cialdini, 2007). People act automatically, not thinking about what rule they should follow, much less notice that they are following it. Teenagers are more aware than adults that they are following social norms; this is motivated by the fact that they are aware that if their values and actions differ too much from those of peers, they risk being cut off from the group. Therefore, many vary their self-representation in such a way as to standardise and to gain more easily social approval. Consequently, they behave according to the rules perceived in the peer group.

Changing a norm must involve a collective change in empirical and normative expectations. Transgressing a norm is costly, so there is usually a slow change in practical expectations as people observe few initial transgressors. Once a tipping point is reached, there is a cascading behavioural change, at which point normative expectations are abandoned.

Social norms and expectations are not universal and may vary between cultures, societies and groups. In some cases, they can limit or harm the individual, leading to a conflict between the need to conform to the group and the desire to express individuality. What may be permissible/usual in one culture may not necessarily be so in others. It is necessary to distinguish the personal, social, economic and cultural factors supporting them and evaluate their relative weight in supporting these practices (Bicchieri, 2017). There are phenomena which several researchers have examined for behavioural changes studies, which are not shared by our culture, but which are traditions in other continents: child marriages, female genital cutting and gender violence. This is precisely why it is essential to understand how we can attempt to change certain behaviours and research the motivations behind that tradition and its origin. Understanding why such a tradition is still performed helps us to understand the reasons that would motivate people to review behaviours that violate fundamental human rights within certain cultures (Bicchieri, 2017) and to identify which aspects (social, economic, cultural, etc.) it would be most beneficial to intervene.

3.3.2 Features of trendsetters

Bicchieri stated in one of her studies (2018): "Different individuals will be willing to abandon a norm in different circumstances". One person might feel ready to abandon a norm even if he believes that only a few people are disregarding it; another, on the other hand, will only reject it if a large majority has already abandoned it. Granovetter and Soong (1983) and Granovetter (1978) show how the exact distribution of these thresholds in a population affects the possibility of change.

Numerous studies have shown that there are characteristics that trendsetters have in common and that favour the abundance of the norm earlier than the community as a whole. Some of these characteristics are (Bicchieri, 2018):

a) Low threshold of abandonment: being the early violators of a norm, one of the main characteristics they must share is a shallow threshold of abandonment concerning the specific model they want to abandon. This is a necessary, though not sufficient, condition to initiate change.
b) Low sensitivity: Sensitivity refers to how much a person adheres to a specific norm. The sensitivity to the model is also linked to personal reasons.
c) Autonomy: Individuals willing to break with tradition are probably also relatively insensitive to general conformity pressures and are autonomous in their decision-making.

d) High perceived self-efficacy: this is defined as the belief in one's ability to influence events in one's life (Bandura 1993).
e) Risk: a factor that determines one's willingness to be a first mover. People particularly insensitive to risk are likelier to be first movers. Those who misperceive risks are also likely to be first movers. One must therefore assess the first mover's perception and risk sensitivity, which can influence the willingness to act.
f) Some other character traits favour the trendsetter's role: creativity, curiosity, courage, non-conformism and eclecticism.

The first mover sends a signal, but to make sure that the signal travels through the network, one has to make sure that the adoption trend can be represented by a bell curve (Rogers 1962); The first part of growth of the graph, and the last of decrease have a lower slope than the central part; in which the spread is represented more steeply because of the greater number of people who adopt (have overcome the initial mistrust) and how after reaching the peak of growth, the number of adopters begins to decline.

Later, some authors took over Rogers' work and made revisions, one of which was Geoffrey Moore in his book "Crossing the Chasm", in which he added stages to the adoption process. Before the early adopters, he said innovators are those with a high propensity to risk and are attracted to new ideas and the ability to try new things first, making new experiences. Being risk-prone, they know they may have to accept the consequences if the investment becomes bankrupt. The early adopters, which according to Moore, are reduced in number compared to what Rogers had analysed, will then be included as the majority of adopters: divided by the majority early that continues to the point where the curve does not reach its peak. Those who arrive later are represented by the point where the curve begins its descent. Finally, late adopters become laggards, who are so sceptical that they risk coming when behaviour/innovation has already been surpassed with an even more advanced one. This dissemination that the available ways of communicating are adequate and that the group's position is strategic.

3.3.3 Simulations

Bicchieri (2018) reports "the social norm game", which implies different scenarios in which the variables of the characteristics of trendsetters are slightly modified, and the impact that this has on the spread is evaluated. As we have seen, the propensity to adopt of the subject is given by various parameters such as sensitivity to risk and norm and the expectation that others follow the standard.

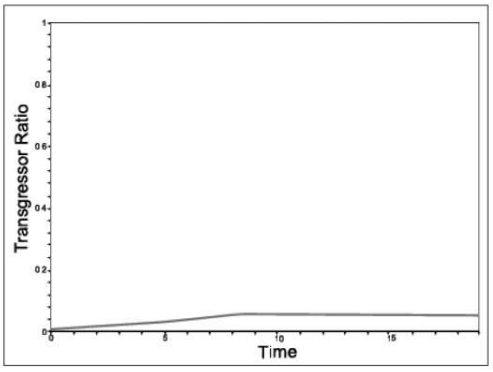
In various situations, the parameter β represents the weight of the local network (the direct neighbours of the individual) about the entire population. In the case of these simulations, a single β is fixed for the whole population without considering the differences that each subject could have. For all simulations, Bicchieri (2018) assumes risk neutrality for all individuals and maintain a consistent payoff structure, risk sensitivity and perception. What will change will be the distribution of sensitivity to the norm to understand the effect on trendsetters better.

Given the range from 0 to 1, where the sensitivity to the norm can vary, in most cases, we assume that the average is 0.5: doing so to a small number matters little or much. In some cases, we set 0.25 to represent a situation where many more people are not very interested in that specific norm (we also assume that the standard deviation is always 0.2, so there is a slight variation in the sensitivity to the model). In each simulation, the sensitivity to the norm of each individual, ${}^{k}i_i$, is drawn from a particular normal distribution.

1. **Village with trendsetter on the outskirts**
   i) $\beta\beta=1$ (same for everyone)
   ii) ${}^{kk}i_i$ drawn from $N\ (0,5,\ 0,2)$

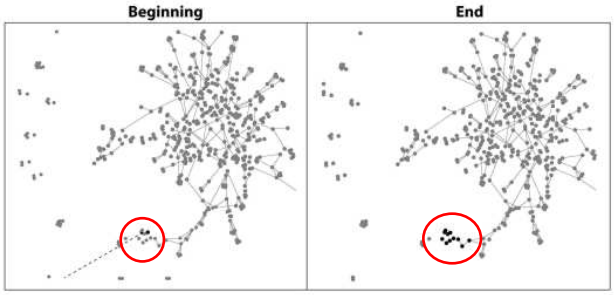
   In the first simulation, we consider a situation in which the trendsetter is located on the periphery of the leading social groups of the village. People only look at their immediate neighbours (family, friends, etc.) regarding norms; average sensitivity to standards is average, and there is relatively slight variation in sensitivity. People, on average, appreciate the model to a moderate extent; the amount of people who enjoy it and do not appreciate it in equal measure is small. Most individuals maintain the empirical expectation that others will continue to follow the norm. The figures below show graphically the reduced growth of adopters over time. In the scatterplot, the fact is more evident because the dark spots (the people who adopted the new behaviour) did not spread.

   Figure 16 - Cartesian diagram



(Source: Bicchieri, 2018)

Figure 17 - Scatter plot



(Source: Bicchieri, 2018)

Figures 16 and 17 represent the course of the diffusion, the first through a Cartesian diagram that compares the time and the transgressor ratio. At the same time, the second is a scatter plot that represents the diffusion through the colouring of the darker dots.

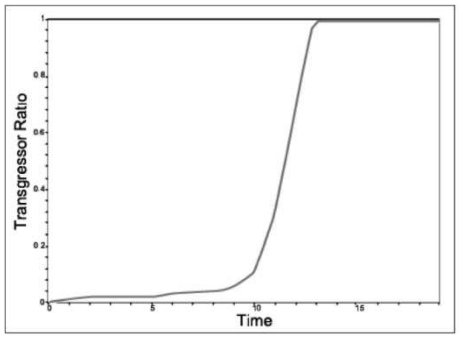
2. Village with trendsetter on the outskirts

i) $\beta=0.7$ (same for everyone)

ii) ${}^{k}i_i$ drawn from $N\ (0,5,\ 0,2)$

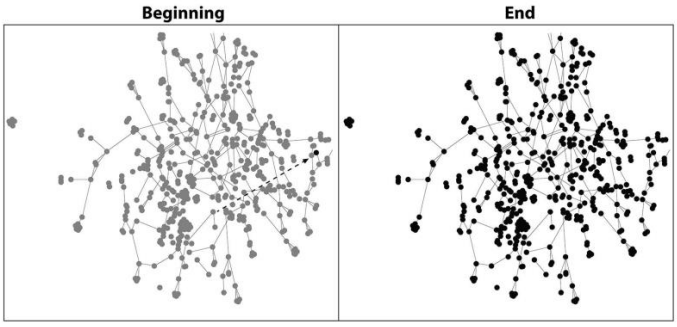
In this case, people pay attention not only to those around them but go a little further. In this case, then the beginning is similar to the previous situation. Still, later, around step 10, you begin to see a surge because subjects with low or moderate sensitivity will be involved in adopting the behaviour. The more people will join, the greater the growth of the next adopters. Shortly after the high point, the maximum diffusion is reached.

Figure 18 - Cartesian diagram



(Source: Bicchieri, 2018)

Figure 19 - Scatter plot



(Source: Bicchieri, 2018)

Figures 18 and 19 represent the course of the diffusion, the first through a Cartesian diagram that compares the time and the transgressor ratio. At the same time, the second is a scatter plot that represents the diffusion through the colouring of the darker dots.

3. **Village with trendsetter in the centre**

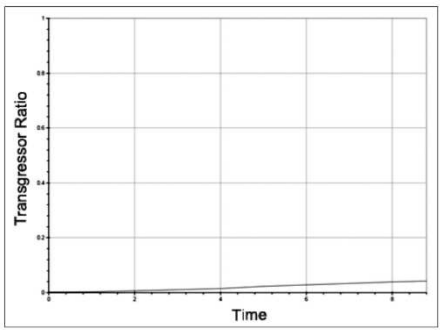
i) $\beta=0.1$ (same for everyone)

ii) ${}^{k}i_i$ drawn from $N\ (0,5,\ 0,2)$

The subject first mover or trendsetter is at the centre of the network, and people only watch what their close neighbours do. In this way, being at the centre, the person can influence a few people, but then the spread stops because it pass only through solid ties.

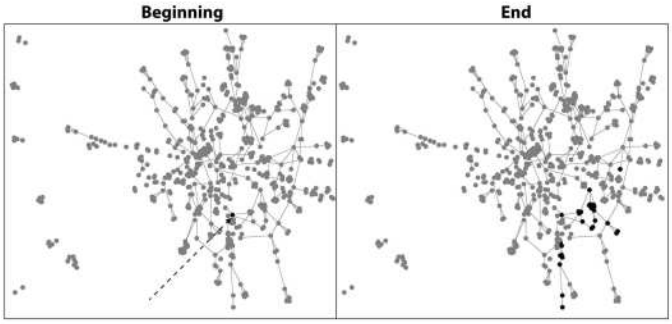
Suppose most people have average sensitivity to the norm and pay attention only to their immediate neighbours. In that case, the abandonment of the model is unsuccessful whether the trendsetter is located in the suburbs (the first simulation) or in the centre (this simulation).

Figure 20 - Cartesian diagram



(Source: Bicchieri, 2018)

Figure 21 - Scatter plot



(Source: Bicchieri, 2018)

Figures 20 and 21 represent the course of the diffusion, the first through a Cartesian diagram that compares the time and the transgressor ratio. At the same time, the second is a scatter plot that represents the diffusion through the colouring of the darker dots, the whole image.

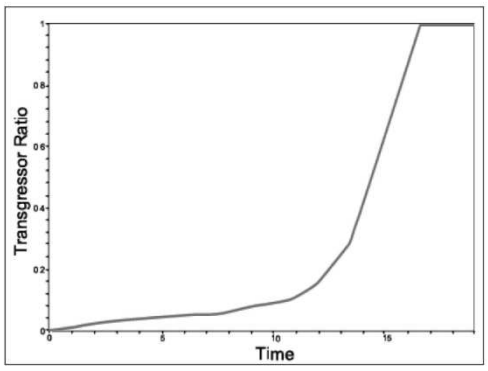
4. Village with trendsetter in the centre

i) $\beta=0.1$ (same for everyone)

ii) ${}^{k}i_i$ drawn from $N\ (0{,}25,\ 0{,}2)$

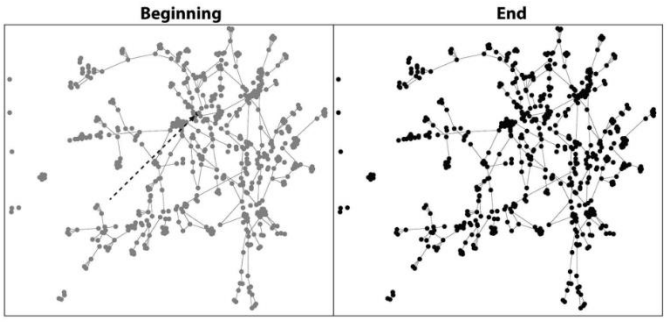
iii) As in the previous simulation, the first mover is in the centre, and everyone looks only at their immediate neighbours to be influenced. Sensitivity to the norm is reduced, and many people will be more susceptible to transgression. Thanks to the combination of the low sensitivity to the norm and the centrality of the trendsetter, diffusion completely takes place.

Figure 22 - Cartesian diagram



(Source: Bicchieri, 2018)

Figure 23 - Scatter plot



(Source: Bicchieri, 2018)

3.3.4 Adoption curve

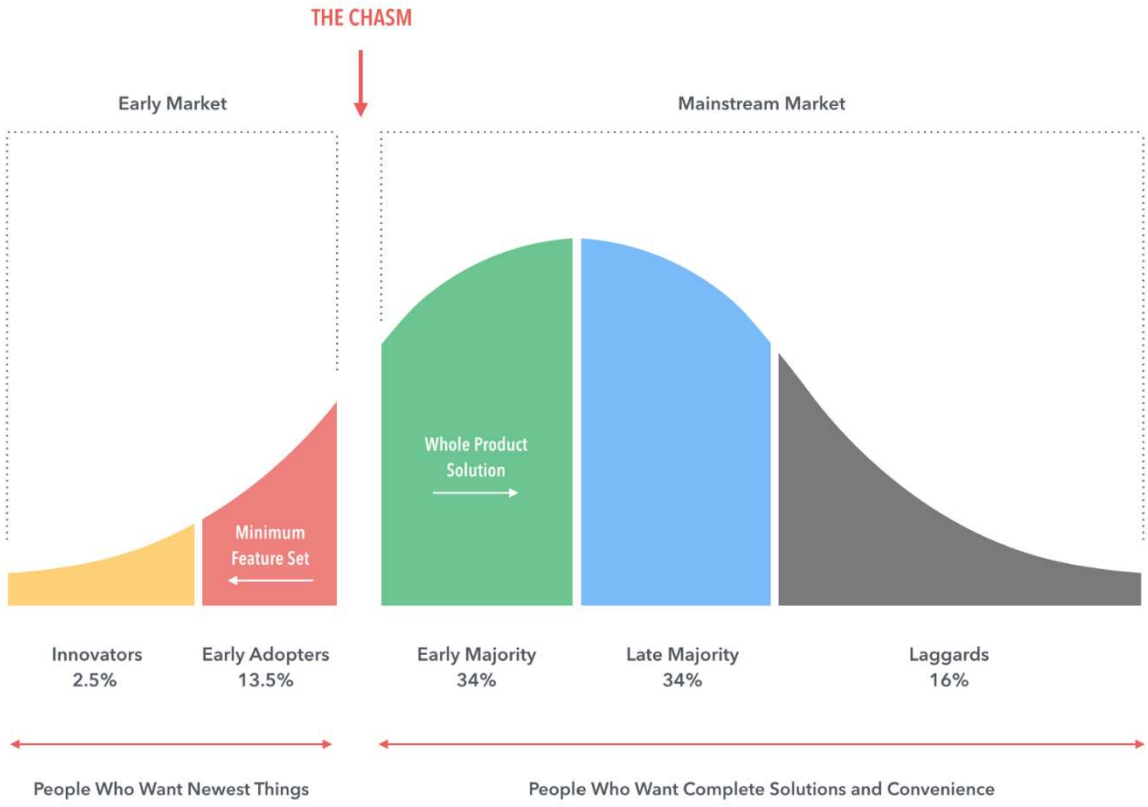
The adoption of behaviour typically occurs in three stages:

a) Early adopters begin to adopt the behaviour; they are usually few and stand out for having low sensitivity to risk and the specific norm.
b) The middle adopters are a very consistent number; they decide to make this choice after seeing that someone did it before them.
c) Finally, the late adopters are those who did not want to take responsibility for the choice before or could not do so and then decide to join when the behaviour has spread.

A bell curve can represent the adoption trend. The former and the latter grow very little compared to those centrally located in the graph.

Several authors analysed the adoption curve and conducted studies about it, starting from Rogers (1962) to the works of Moore (1991, 1999, 2014). Geoffrey Moore's book "Crossing the Chasm" (2014) explained the whole stages of the adoption process. Before the early adopters, he analysed innovators, those with a high propensity to risk and are attracted to new ideas and the ability to try new things first, making new experiences. Being risk-prone, they know they may have to accept the consequences if the investment becomes bankrupt. After the early adopters, the majority of adopters will be included: divided by the majority early that continues to the point where the curve does not reach its peak and those who arrive later, represented by the point where the curve begins its descent. Finally, after late adopters, some laggards are so sceptical that they risk coming when behaviour/innovation has already been surpassed with an even more advanced one.

Figure 24 - Rogers curve revised by Geoffrey Moore



(Source: "Models for Predicting the Future: Geoffrey Moore's Crossing the Chasm", Matt S. Smith, 2018)

The first two groups are innovators and early adopters who want to be at the forefront and represent the novelties first. At the same time, the rest of the three groups represent those who prefer convenience and evaluate effectiveness before investing.

3.4 The power of social contexts

Building a map of people's relationships would be easier if people knew whom they were connected to, but most of the time, people cannot remember whom they talk to on a specific day and even more so throughout the year. People do, however, know where their offices are, which work groups they belong to and what their favourite places for lunch are. Harnessing this information is the key to gathering data on their identity and building networks accordingly. In many companies, from any sector, members of an organisation are often assigned to participate in working groups or project teams. These are environments where people meet regularly in the same social space, perhaps for weekly or bi-weekly meetings. The same happens when colleagues have the same routine and meet periodically for coffee breaks in the corridor or lunch in the same place.

However, if the latter is enormous, the meeting may occur in different spaces when working in the same company. Still, working together within the mentioned work groups is possible. This allows an interchange of resources; a person's contribution outside the usual work context can make it very relevant. Changing the location of the meeting can also be advantageous; many of the most fruitful encounters occur in the social context that stems from the lunchtime culture at MIT[13], where (weather permitting) most lunchtime conversations take place around the food trucks along the MIT campus. New friendships, advisory relationships, and research collaborations can arise from these casual interactions between employees, business people, recent graduates, students, etc.

It is possible to identify the network structure within the company by mapping the profiles of each member. A person's profile can be defined by identifying their activities, the time and place they take their breaks or lunch, and the people they work with directly and indirectly, temporarily or regularly. The results of studying this network may reveal the best ways to change the social contexts of an organisation to increase its capacity for innovation.

Mapping the corporate network can bring numerous benefits, one of which is demonstrated by taking the example of an ecological start-up within a company. Consider a social change initiative to reduce the carbon footprint of an organisation. An engineering research group within the company wants to promote a policy that reduces the consumption of non-recyclable paper products in the organisation's daily activities. The request from these parties implies a change in the routine activities of all stakeholders. Consequently, for example, there could be a change in the relationship with suppliers. Asking people to adapt to a green initiative may be inconvenient and entail asking them to do extra work. Therefore, the challenge of mobilising change within an organisation mainly concerns asking people to change their routines or add additional work at the beginning.

If a group is determined to reduce the use of paper for the sake of the environment, it can start by asking colleagues with whom they work in the same temporary work group to work with electronic documents instead of paper. If the individuals are comfortable using this method, they could also bring it into their offices and introduce their colleagues to this innovation. This contamination is the advantage of building group work and 'mixing' people from different offices and departments, making them work with a single objective.

[13] MIT is an Institute that has built a robust tradition of solving problems in the public interest at the intersection of technology and humanity. It was founded in 1865 in Cambridge, Massachusetts. It is located across the Charles River from Boston, in the vibrant innovation district of Kendall Square. At MIT people revel in a culture of learning by doing. In 30 departments across five schools and one college, students combine analytical rigor with curiosity, playful imagination, and an appetite for solving the hardest problems in service to society.

The strength of this exchange of ideas, behaviour and ways of doing things lies precisely in breaking the rigid patterns created within an environment where there are always the same people and ways of working. The more the initiative is spread, the greater the chance that more people will adopt it within their work routine and the more significant, consequently, will be the impact the organisation will have on the planet. Although it was a small gesture in this example, the consequences of adopting this practice by all employees can have significant impacts.

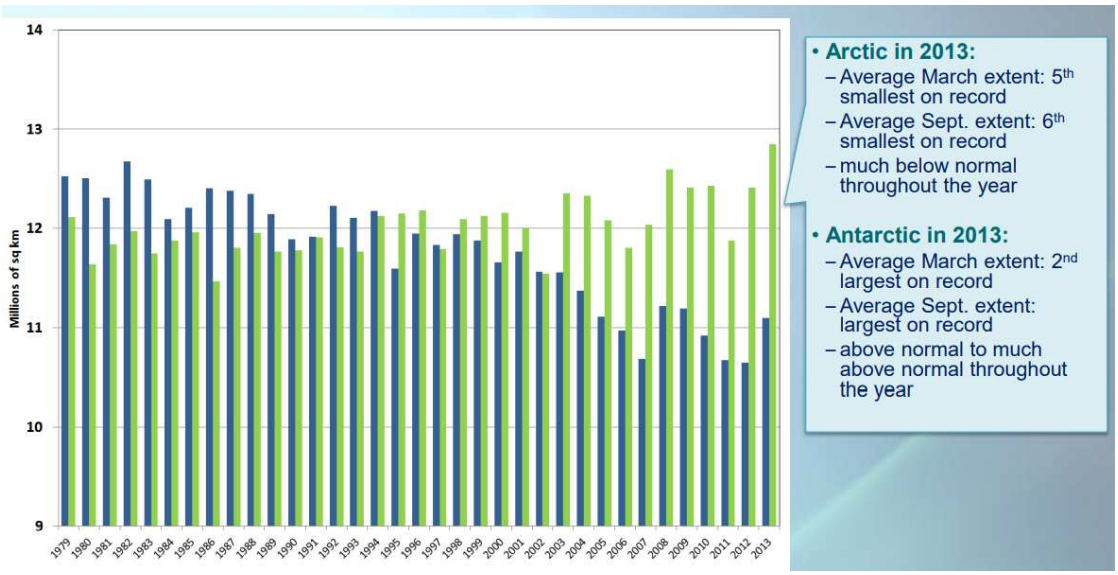
The results show that defining organisational identities within an environment can help shape social networks to enhance the dissemination of complex knowledge and innovative practices. It was seen how the right kind of homophily could create empathy between strangers, providing a rare and valuable form of social capital. If one person feels similar to another, they will tend better to understand the interests and motivations of the same. They will find it easier to introduce directly or indirectly suggested behaviours. Not only similarity should be valued, but also diversity. Centola (2018) analyses legitimacy; in this situation, the fact that someone deviates from common thinking and is 'different' encourages others to behave similarly if they share the thought or behaviour. The relational context, therefore, in which network ties are embedded can shape the way social capital is used and thus influence behaviour and the spread of innovative practices.

3.4.1 Contagion infrastructure for the acceptance of new ideas

Some people are more accepting of new ideas than others; an example is the recent NASA studies on global trends in Arctic sea ice. This is an essential parameter for assessing climate change, temperatures, salinity and seawater height. Over the last thirty years, NASA has used orbital satellites to document Arctic trends and decided to release to the public the results.

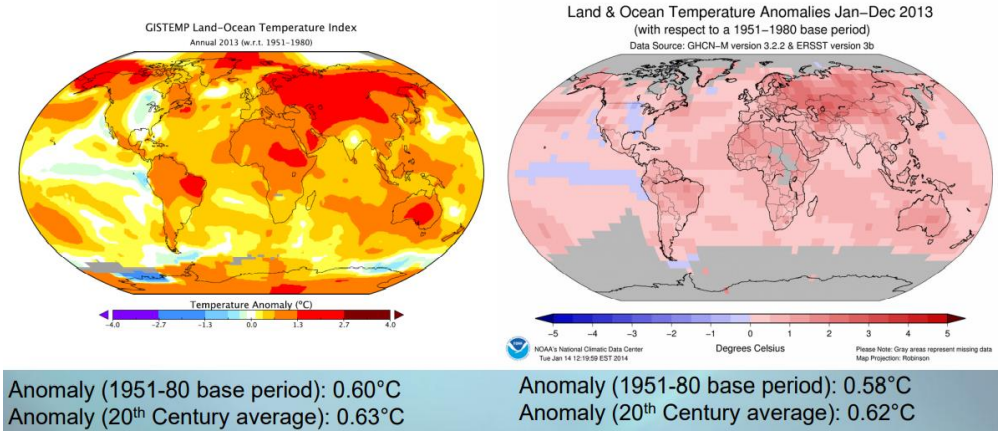
Once NASA's studies were released, scientists expected people to realise the severity of glacier melting and change their routines to improve the situation. Although the published graphs showed a continuous downtrend in the presence of glaciers, some people claimed to confirm their opinion that experts and the media were exaggerating the issue of climate change. They also used the graphs as proof of what they claimed. But other groups of people, thanks to this study, had the reaction that scientists imagined and realised the importance of acting as soon as possible.

Figure 25 - Annual 2013 average sea ice extent: Arctic (blue) and Antarctic (green)



(Source: 2013 Global Temperatures, NOAA/NASA)

Figure 26 - Annual 2013 temperature by NASA (left) and NOAA (right)



(Source: 2013 Global Temperatures, NOAA/NASA)

In 2017, a study was carried out by Centola and two graduate students, Guilbeault and Becker, in which conservatives and liberals were asked to predict the Arctic sea-ice levels in 2025. Most liberals understood the graph to mean that Arctic sea ice was decreasing; to the contrary, nearly half of conservatives concluded that Arctic sea ice levels were increasing. The latter imagined that the group in 2025 would be significantly higher than the present day. According to them, all the global warming campaign was in vain, and all the techniques to improve the situation were useless because they would have enhanced themselves soon.

Social networks are channels through which much information passes, but we have seen that only some receive it similarly. Social networks sometimes filter what one wants to communicate through social media or face-to-face. Often people, to reinforce their thinking,

surround themselves and share with others who think the same way as they do; in this way, they do not have the chance to see the situation from another point of view; on the contrary, they only convince themselves more and more. The use of echo chambers[14], which can be compared to the organisational silos of a company, limits the view; they do not allow access to all the information available. To avoid this handicap, wide bridges are needed to increase the flow of information between groups and communities.

After realising the difference in views between democrats and republicans, Centola put them together in the same social network, providing them with an environment where they could directly confront each other on the same issue. He observed how people with such different opinions could discuss. Each social network featured the logos of the two political parties in the bottom corner of the screen, consisting of forty people (twenty Republicans and twenty Democrats) connected by a fishing net structure. Repeating the experiment 20 times, they had surprising results. Despite having the opportunity to compare themselves with others and learn something new, the people did not change their views; this happened all twenty times the experiment was repeated. It was later decided to replicate the investigation with the same methods and number of people, the only difference being removing the two political logos on the screen. It was soon realised that the situation was completely different; people started to see the graphs 'correctly' without political bias. There was a richer and more fluid exchange of information and opinions, and the predictions of all participants, regardless of whether they were Democrats or Republicans, became more accurate than the researcher had expected. Both groups achieved an accuracy of almost 90% in the interpretation of the NASA study graphs. And all twenty times, this result was achieved. In every one of the twenty groups where we connected Democrats and Republicans into a network of wide bridges across the aisle, the results showed dramatic improvements in their ability to interpret climate trends. Findings showed that the cause of intergroup enmity is not the interactions themselves but how those interactions are framed. People determine who is the in-group and the out-group and implicitly define the boundaries of social influence. Interactions across groups must be prepared to make diverse participants relevant to each other to facilitate learning and mutual understanding. It is necessary to avoid ways in which interaction stirs feelings of political loyalty because this reduces people's ability to listen to diverse opinions and even to see the facts. Researchers decided to try a new experiment version, working on a centralised network. For this reason, the groups now have been divided into a single firework explosion rather than a fishing net. They

[14] Echo chambers are the contexts and conditions that lead to the creation of a state of ideological isolation of individuals. Within the so-called echo chambers, in fact, news and sources would circulate with a confirmatory nature precisely of the political, religious, etc. positions of individuals.

experimented with randomly choosing different people to be in the centre of the network, sometimes a Democrat, other times a Republican. This type of organisation of the groups made the entire population biased toward the central person's point of view. Even small biases of the main person can increase the population's tendency toward that opinion. The results showed that the problem is less severe in more diverse groups, such as networks of Democrats and Republicans with a wide range of views. On the contrary, the situation worsens when the groups are composed of similar minds. People's different viewpoints can help mitigate a central individual's bias.

3.4.2 Tipping point to make the difference

The studies of Centola (2021) have been based on the hypothesis that every coordination game has within it a tipping point[15]. If the tipping point existed, changing social norms would make it easier. The population's habits could be influenced more quickly and precisely; it would be enough to work on a limited number of early adopters to see results. The words we use, how we behave in society, and the initial greeting could change everything from one social norm to another.

As we have seen, the fight against climate change is one of humanity's most critical challenges. To meet this challenge, it is crucial to significantly reach a significant number of people engaged in the fight against climate change in the primary sector. When many people come together and engage, it can create a considerable impact and greatly influence governments and businesses. People working in agricultural enterprises must adopt methods that reduce the adverse effects of their activities. If some of them succeed in inventing new techniques to help protect the environment and the well-being of their cultures, they can ensure that their method spreads and is reproduced by their related companies. Just as with intensive livestock farming, if a farmer invents a technique to lower the level of greenhouse gases produced by his animals or creates a watering system that does not waste water, these behaviours can be developed in other companies if he succeeds in spreading them.

Therefore, reaching a significant number of people engaged in the fight against climate change can be even more relevant if we rely on the tipping point theory. It would be necessary to make targeted policies that convince the green commitment of at least several people within some environments. In such a way as to create the hardcore, the others are dragged by the first group; even better would be the situation in which convinced people are in charge. In such a way that,

[15] The point at which a novel behaviour gained enough traction that everyone's opinion about what was acceptable would suddenly change.

in addition to state rules, internal rules are promoted within the company, society or any analysed environment.

There are some strategies, depending on what the subject is, that can contribute to reaching the tipping point.

1. The **shotgun strategy**: based on the principles of viral marketing, it is possible to distribute your resources broadly. It is necessary to select, for example, ten people in each community to be targets or "change agents" for spreading the innovation and giving each person one dollar to adopt the creation and spreading the word about it. The change agents must be chosen from widely distributed parts of the community's social network, creating, in this way, maximum exposure for the selected innovation. This strategy has the problem of a lack of social reinforcement.
2. The **silver bullet**: The influencer strategy finds the most charismatic and highly connected person in the social network and gives them the total budget to promote the innovation to everyone. This individual is remarkably well-connected and influential and has the power to trigger a chain reaction that transforms the entire community's social norms. The problem is that if the subject is delicate, like the example of Korea's contraceptive campaign, a highly connected person is unlikely to be incentivised to come out publicly against the status quo.
3. The **snowball strategy**: It targets unique places, instead of notable people, in the social network where innovation can take hold. This strategy aims to incubate support for your creation, to grow a critical mass. As in the shotgun strategy, it is necessary to choose some people to use and spread the innovation; but instead of picking ten people who are dispersed far and wide in the network, it is better to choose people from the same social cluster. Change agents know one another. The snowball strategy would be a waste of resources for a simple contagion. On the contrary, it would perfectly work for complex contagion. Spreading a social norm, this strategy makes work the redundancy, which is efficient in this type of contagion.

These strategies were applied in a study involving farmers adopting the pit-planting technique in Malawi. Beaman and her team conducted the research, and the experiment lasted three years, from 2011 to 2013, even though they worked two years before the start. In the first year, the researcher went village by village conducting interviews, asking whom they trusted, whom they took as an example, and whom they talked to on agricultural issues. In the second year, in collaboration with the Malawi government, she formed a small group of change agents who were tasked with learning the pit-planting technique to the best of their ability and then trained

other farmers in the village who wanted to undertake this innovation and also gave them the necessary resources. She divided the 200 villages into four groups. She used the four tipping strategies: shotgun, snowball (friends in common), snowball-neighbourhood (same single residential neighbourhood) and silver bullet. It was soon noticed that farmers connected to more than one change agent were 200 times more likely to adopt the technique than those related to only one. The least effective technique was the silver-bullet influencer technique, it turns out that it did not bring benefits either in terms of dissemination of knowledge or in terms of adoption. One technique that performed slightly better was the shotgun strategy. The best designs, however, were the two snowballs. The snowball neighbourhood increased awareness by 50% compared to the shotgun strategy, but it still needed to be a better strategy in terms of adoption. Based on network architecture, the snowball (friends in common) had the best results: it produced a 300% increase in adoption compared to the shotgun strategy. And the dissemination of information about the innovation was also high. It was thus proven through this experiment that often, for complex contagion, the most helpful technique is snowballing. By leveraging the relationship between people who trust each other, it is possible to exercise the social reinforcement that complex contagion requires.

CHAPTER IV – Experiments and results from the field

The dissemination of new technology within a community can occur in several ways. Still, one of the most effective is undoubtedly through the identification of central individuals within a social network. These individuals have a position where they pass to their contacts information and knowledge about the new technology. Various theories have studied how best to make the diffusion process work, some focusing on geographical proximity, others on individual relationships. In the following, we will look at field experiments in which the theories best suited to that situation will be evaluated.

4.1 Malawi experiment

Beaman L. and his collaborators conducted a few critical experiments in the field of agriculture and behavioural diffusion: "Making networks work for policy: evidence from agricultural technology adoption in Malawi" (2016) and "Can network theory-based targeting increase technology adoption?" (2018, 2021).

The experiment took place within 200 villages in Malawi, located within three districts with characteristic semi-arid climates. The first village, Machinga, contains 112 villages; the second, Mwanza, has 30; the last, Nkhotakota, includes 58. Most of the population farms maise and lives in rural areas (about 84 per cent of Malawians, World Bank 2015). More than 60 per cent of the population's calorie consumption in Malawi derives from maise, 97 per cent of farmers grow maize, and over half of the households grow no other crop (Lea and Hanmer 2009). Malawi is one of several African countries that have unexploited opportunities for greater maise yields (Udry 2010); for this reason: technology adoption and productivity in maise are therefore crucial for the exploitation of present resources and improving the lives of the population. The internal study was carried out with the support of the Malawi Ministry of Agriculture and Forestry (MoAFS). Malawi's existing agricultural extension system relies on Agricultural Extension Development Officers, henceforth extension agents; the MoAFS employ them. Many extension agents are responsible for upwards of 30-50 villages: direct contact with villagers is rare. This causes a low percentage of farmers' participation in extension activity (more or less 18%). The experiment was carried out in four different ways. The first is the primary method: the Benchmark treatment, i.e. the status-quo benchmark, in which dissemination agents were asked to select two seed growers to train as they would typically do in settings outside the experiment. The other three modes are based on the threshold diffusion model; The threshold model of diffusion postulates that individuals adopt a behaviour only if they are connected to at least a threshold number of adopters (λ). A partner who would be the "theoretically optimal" choice as a seed was then chosen according to alternative formulations of the threshold model

(e.g. Granovetter 1978, Centola and Macy 2007, Acemoglu et al. 2011). The second method concerns Complex Contagion: this treatment identified seeds by maximising the simulated spread when $E\ [\lambda] \approx 2$ using network relationship data. It is possible to find the two selected sources in very central areas of the network. The third relates to simple contagion: this treatment identified origins by maximising the simulated spread when $E[\lambda] \approx 1$ using network relationship data. Usually, one source is central, while the other is spherical and reaches a more distant point in the network. The last one is called geo treatment: this treatment typically identifies two seeds near each other in the network but are not central. This resulted from maximising simulated diffusion when $E[\lambda] \approx 2$ using network data constructed using only geographic proximity. Extension agents chose the seed farmers in the Benchmark villages, and the researchers determined the seeds in the remaining treatment villages.

The two technologies introduced to seed farmers in the experiment were pit planting and crop yields.

The pit planting technique was practised only by 0,22% of the test—maise farmers in that territory, traditionally planting seeds in either flat land or after preparing ridges. Ridging has terrible consequences for farmers: it depletes soil fertility and decreases agricultural productivity over time (Derpsch 2003, 2004). In contrast, pit planting involves planting seeds in a shallow pit in the ground to retain more excellent moisture for the plant in an arid environment while minimising soil disturbance.

The authors showed that pit planting increased yields by 44% for trained seed farmers. The enhanced productivity comes from three mechanisms:

1. Reducing tillage of topsoil allows nutrients to remain fixed in the soil rather than eroding;
2. Concentration of water around the plants aids in plant growth during poor rainfall conditions;
3. Improved fertiliser retention.

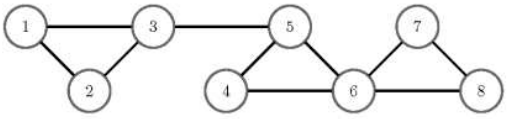
There are also costs to consider, although the benefits are higher. More herbicides and manual weeding would be best as you work the soil less. Another charge relates to the initial phase in which ditches must be dug, although the work becomes progressively more accessible with time: soil preparation time is reduced by 50% in 5 years (Haggblade and Tembo 2003).

Crop residue management[16] (CRM) has also been taught to farmers. Before using CRM, farmers used to burn crop residues in the fields and remove them for use as cattle feed and compost. The importance of retaining crops in the areas is to protect the soil, reduce erosion and limit weed growth by moistening the ground.

This field experiment, conducted in collaboration with Malawi's Ministry of Agriculture, showed that farmers tended to adopt sowing in villages where the two trained seed growers were at the centre of their villages' social network. Another key finding was that the two partners must be located close to each other so that the obstacle of complex contagion can be overcome: if a threshold is more significant than one is needed. It also emerged that farmers who are connected to two seed growers are also more likely to adopt pit sowing in the second year of the experiment. The methodological approach of this work entails high network data collection costs; however, with specific interviews, it is possible to identify the central individuals and then develop the network to trigger the dissemination process.

To better understand the mechanism behind complex contagion, it is possible to analyse a thought experiment; we train two seed farmers in period 0 so that they are fully informed about a new technology. Dissemination takes place when, during subsequent periods, other farmers are informed and adopt the technology.

Figure 27 - An example network



(Source: “Can Network Theory-based Targeting Increase Technology Adoption?” Beaman et al., 2021).

Beaman et al. (2021) reported a thought experiment to understand the diffusion process. The law on the farmer's knowledge of the technology is based on the moment another farmer informs him: simple contagion.

- In period 0, the seed farmers are informed of the new technology.
- In period 1, the ideal farmers will be farmer six and then farmers 1, 2 or 3, so, in this case, all farmers are informed.

[16] A set of agricultural practices that largely focus on keeping crop residues in the fields for use as mulch.

Even with other reference schemes on the social network, 70% of the population tends to be informed by the end of period 2.

The situation is distinct in a different case from the one just presented. If people need to know two informants to be fully informed, the spread is slower than in simple contagion. Those who are trained are five and eight.

- In period 1, the trained farmers both inform farmer 6.
- In round 2, farmers 4 and 7 are informed by 6, who can be called fully informed in addition to the knowledge transmitted by 5 and 8.

The diffusion process stops with 3 of the six possible non-sowing farmers informed. Gaining more than the diffusion rate (50%) is impossible. Identifying central or strategically placed individuals within the network is essential to spread the technology as widely as possible, even if complex contagion is required.

Social learning influences adoption decisions (e.g. Griliches 1957, Conley and Udry 2010). Three characteristics of a learning environment:

1. Adopting new technology occurs only when farmers' beliefs about the profitability of the technology pass a critical threshold.
2. There are limited inherent benefits to learning about technology if farmers are not ultimately persuaded to adopt it.
3. Farmers must invest time to learn about and master a new production technology; this can count as learning costs. In addition, revealing ignorance may subject them to social charges (e.g. Banerjee et al. 2020; Chandrasekhar, Golub and Yang 2019).

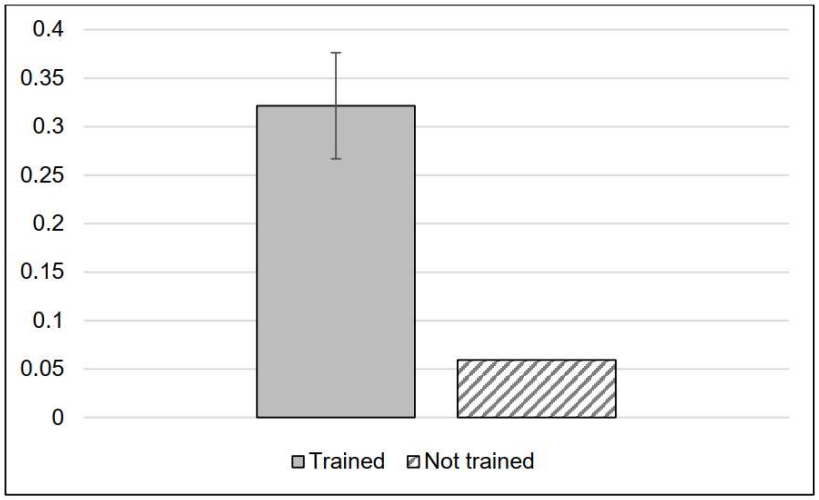
The experiment showed that targeting central farmers has many benefits for technology dissemination, but at the same time, studying and mapping the social network is expensive. The geography-based approach was an attempt to assess how far the dissemination benefits of applying network theory could be achieved without having to resort to costly data collection methods, as the physical location of each household is much easier to locate and is less expensive than searching for relationships within the network. However, the geographical method did not achieve the desired results. One of the main reasons this method did not work was that where there was a large density of farmers in the same area, there was little arable land from each, making people poorer and, therefore, less inclined to invest in new technologies.

A more manageable situation to collect data from the network was assumed: an extension agent entered a village and randomly selected a small group of farmers to be interviewed, asking the

interviewees only one question: 'Do you often discuss agriculture with anyone in the village? What is the name of the person you often discuss agriculture with?". In response, a list of names of people connected to the interviewee will be generated. Using simulations, we predict that strategies that exploit the highest degree of respondents in the random sample can approach the performance of optimal targeting: 73% of the optimal adoption rate can be achieved with only two full interviews, and 84-90% of targeting gains can be completed with about seven interviews.

4.1.1 Results of previous studies

Figure 28 - Adoption of pit planting through partner farmers trained



(Source: “Making networks work for policy: evidence from agricultural technology adoption in Malawi”, Beaman et al., 2016)

In the work of Beaman et al. (2016), it has been documented that seed growers trained in the technologies are more likely to adopt the technology themselves: realising some productivity gains from sowing in the pit and persisting with adoption. Furthermore, it has been proven that some seed types are more network-centric than others. Next, it was verified that seed growers assigned a communication role make an effort to disseminate information about pit sowing to their neighbours in the village or those they are connected to within their network. In addition, training partner farmers on pit sowing increase adoption.

Results based on network theory say that it increases adoption by 3-4 percentage points more than when relying on the extension worker. Technology adoption rose from 0% to 10% in the experiment's three years. Using theory-based procedures to identify seeds leads to a 50% higher probability that at least one other person in the village will adopt them. The low-cost geographic targeting strategy generates some gains in adoption compared to the status quo benchmark; this is a much cheaper strategy to implement. Furthermore, there are methods for low-cost

identification of social network structure in a more relevant and scalable manner. Banerjee et al. (2014) showed that in India, an interview with a single question, "If we want to spread information about a new loan product to everyone in your village, whom would you suggest we talk to?" is successful in identifying individuals with high eigenvector centrality and spread centrality. Surprisingly, this economic technique differs from the process followed by government disseminators in Malawi, even when they are given complete freedom to select seeds. Seed growers selected by AEDO showed lower eigenvector centrality than seeds selected through the network-based simulations of the Beaman et al. experiment.

4.2 The case of hybrid corn

Hybrid corn is a variety of corn obtained by crossing two lines to combine the best characteristics of both, such as disease resistance, productivity, seed quality, drought tolerance, early ripening, etc. This type of corn has been a real revolution in the agricultural sector because it has significantly increased corn production in the United States since the mid-1930s. Thanks to hybrid corn, farmers have been able to harvest more and better crops, increasing the productivity of their crops.

Numerous studies have been conducted on hybrid corn to understand its genetic characteristics, the mechanisms behind its success and to develop new varieties that are increasingly adaptable to different environmental conditions and farmers' needs. In addition, the role of hybrid corn in creating new opportunities and challenges for the agricultural sector, including dependence on pesticides and issues related to biodiversity and food security, was also assessed. Hybrid corn has many advantages, for this has been the subject of numerous studies; some of these features are:

- Increase in production,
- Suitable for mechanical corn pickers,
- More drought resistant.

The most accredited study, which focused on diffusion, was conducted by Ryan and Gross in 1943. The authors pursued this qualitative research by focusing on introducing and adopting hybrid seed corn in two communities in Iowa, where 259 farmers were interviewed.

The main questions asked to the respondents were: where and how they learned about the new agricultural product, and after how long from the knowledge of existence they adopted it. What they focused on then was: the period of expertise, communication channels, quantities of corn planted per year, and personal information of the farmer for profiling. What came out was surprising: years passed from the moment of knowledge to full adoption. The first adopters

gradually gained confidence in the hybrid corn and increased the field cultivated with this product type yearly.

It was also seen that the trend of adoption was divided into three periods:

1. Long period of slow growth,
2. Steep growth following extensive adoption,
3. Slight decline as adopters accepted innovation.

The earliest adopters performed a unique function for their communities in their roles as "experimenters"; those who were reluctant could see the benefits they brought to the neighbours who had already adopted the new corn. The neighbours, therefore, played an essential role in the spread; the first to make the product known in some cases were the sellers, but most of the respondents said that thanks to the neighbour's experience were convinced of the validity of the product. The critical role of interpersonal networks in the dissemination process in a system was highlighted: the exchange of personal experiences between farmers with hybrid seeds is at the heart of the spread. Ryan and Gross sensed that the space of hybrid maise in Iowa communities was a social snowball; the more they talked about the product, the more knowledge it raised and then adoption. The validity of the hybrid corn was experimented with and, in most cases, convinced the purchase increase. There was complete adoption within a few years. The rapid adoption of the innovation was related to specific personal, economic and social participation characteristics of the farm operator. It is also necessary to specify that the "leadership" that many farmers had in convincing others to adopt those farm practices to other "colleagues" was not related to established leadership roles in the community; it was situational. They relied on the experience of each other to take advantage of the innovation.

Conclusion

Our analysis showed that the network created through relationships between people plays a central role in disseminating innovative practices and technologies.

At the beginning of this work, I analysed the consequences of climate change and the risks we run if we do not act quickly. Global warming is a phenomenon that involves the suffering of populations and the death of many species of animals, with catastrophic consequences for biodiversity; it also causes severe damage to territories and oceans. Companies can take action to limit, if not stop, this scenario. These one have human and economic resources to change harmful behaviours, transmit environmentally friendly behaviours and policies, act sustainably in the purchase and production part, and favour eco-friendly materials and methods, demonstrating that sustainable growth is feasible and favoured.

In the second chapter, we have seen the effects of climate change on the entire primary sector, which includes agriculture, forestry, fisheries, livestock and mining. We have seen that the activity of livestock, particularly intensive livestock farming, involves considerable environmental damage. We have seen that about 30% of global biodiversity loss is attributable to livestock farming caused by deforestation, intensive agriculture, soil depletion and desertification. To mitigate the negative impact of agriculture on climate change, it is possible to implement sustainable agricultural practices such as conservative agriculture, agroforestry and organic farming. These practices can help reduce greenhouse gas emissions, improve soil health and increase resilience to climate change. For example, agroforestry involves cultivating trees alongside crops or livestock, which can seize carbon and help protect against extreme weather events. Finally, we saw the seventeen Sustainable Development Goals declared in the 2030 Agenda; those related to the sector that we considered are No poverty, No hunger and climate change mitigation. To promote the achievement of these objectives, we must work to create a mentality that is inclined to accept eco-respectful and sustainable working methods. After analysing the major behavioural change studies, I chose to take the agricultural sector as an example to apply the theories. In addition to being one of the leading sectors of climate change, both for the amount of damage it suffers and for those it creates, Europe has an interesting organisation. Often in EU, agricultural enterprises are organised in family contexts of small size; it is therefore assumed that most need to possess cutting-edge technologies, innovative products and revolutionary methods to reduce pollution and help the environment. The importance of the net is then understood, following the reflection that we are a population organised mainly by society, in which, therefore, an individual is often unconsciously influenced by those around him. The bonds that exist can be relationships, such as parents,

siblings, friends, and relatives and therefore solid ties, or others that are only knowledge or weak links, but that can still be useful within the network of an individual, above all having the objective of the diffusion of information. In addition to the importance of relations within the network, we also evaluated the role of economic incentives. Some of the measures that governments can take to avoid more significant negative consequences for businesses are environmental taxes (environmental taxes can be introduced on goods and services that harm the environment, this makes polluting products more expensive for consumers, encouraging the adoption of greener alternatives), environmental subsidies (environmental subsidies may promote the adoption of environmentally friendly behaviour), tax breaks and recycling programmes. Regarding economic incentives, a study by Beaman et al. (2014) was analysed in which a loan was offered to farmers' families in 110 villages in Malawi, who could accept or refuse; one-time scholarships were awarded to some families of these 110, and to rest of the villages included in the study. You can see from the experiment that those who accept the loan also have higher marginal returns, so there is a self-election for credit in the communities. Another significant achievement was assessing the impact of grants on the community, which had even better effects than loans. This led to increased investment in inputs, outputs and profits in the same and the following years. A person's opinions and behaviour can often be strongly influenced by the group to which they belong or by which they feel stimulated; some of the best-known features of social influence processes are the following:

- Strategic complementarity/Coordination: the value of behaviour increases with the number of others who adopt it. In ‘network effects’ situations, the economic value of choice may depend on how many others have made the same choice.
- Credibility: the more people adopt a behaviour, the more credible it is that it is beneficial or worth spending 'the cost of adoption'. The propensity to innovate increases when known people adopt the technology or behaviour.
- Legitimacy: the more people adopt a behaviour, the higher the expectation that others will approve of the adoption decision and the lower the risk of embarrassment or sanction. Battles are being waged on many 'sensitive' issues nowadays to normalise matters.
- Emotional contagion: the emotion associated with adopting a behaviour increases with the number of others who embrace it. Diffusion can first be studied on a cluster network, and then 61 observed when long ties are introduced.

All these characteristics justify the complexity of transmitting information or behaviour through various links. The kind of dissemination also changes according to the message type; if an

effective method is found to disseminate a job offer announcement, the same methodology may not necessarily apply to a different kind of request, such as the sale of a product. Each message category has an appropriate communication structure to be identified and used. Although we influence each other within a network, there are individuals whom scholars call "seeds", who have more relevance than others within a group. These individuals, known as trendsetters, are the ones who first begin to create trends and lifestyles that differ from the rest of the group. Their ability to act independently and go against the predefined canons makes them exciting and unique. To spread sustainable practices and innovations in this regard, we can also rely on these people, who have a central role in the network. Centola (2021) based his studies on the hypothesis that every coordination game has a turning point. If the critical issue existed, changing social norms would make it easier. Population habits could be influenced more quickly and precisely; it would be enough to work on a limited number of early adopters to see the results.

The fight against climate change is one of humanity's most critical challenges. To address this challenge, it is crucial to significantly reach a significant number of people engaged in the fight against climate change in the primary sector. Therefore, the involvement of a substantial number of people in the fight against climate change can be even more relevant if it is based on the theory and studies conducted to this day. It would be necessary to make targeted policies that convince the green commitment of at least several people within some environments. To create the hardcore, the first group drags the others; even better would be the situation where convinced people are in charge.

There are some strategies, depending on what the subject is, that can contribute to reaching the tipping point:

1. The shotgun strategy: based on the principles of viral marketing, it is possible to distribute your resources broadly; it is necessary to select some people in each community to be targets or "change agents" for spreading the innovation and giving each person resources to adopt the creation and spreading the word about it.
2. The silver bullet: The influencer strategy finds the most charismatic and highly connected person in the social network and gives them the total budget to promote the innovation to everyone.
3. The snowball strategy: It targets unique places, instead of notable people, in the social network where innovation can take hold. Instead of picking some people who are dispersed far and wide on the web, like the shotgun strategy, it is better to choose people from the same social cluster. Change agents know one another.

These strategies have been put into practice in an important study in the economic literature of Beaman et al., in which the most effective methods for the spread of a new method of cultivation have been studied to benefit farmers in some areas of Malawi. The pit-planting method is particularly effective in arid soils. It promotes the conservation and exploitation of water for the plant because it is planted closer to the surface than usual; it also encourages the reduction of pesticides and allows the natural substances of the soil to be not too dispersed. Four different strategies have been applied within the 200 villages considered: the silver bullet, which is the solution that the Malawian government came to through its extension agents; the shotgun in which the people chosen were distant from each other; the snowball strategy in which resources were selected within the central position of the network area; and finally, the geo treatment in which two seeds near each other in the network but are not central were chosen. Beaman et al. (2021) found that farmers tended to adopt sowing in villages where the two trained seed growers were at the centre of their villages' social network. Another key finding was that the two partners must be close to each other to overcome the obstacle of complex contagion. It also emerged that farmers who are connected to two seed growers are also more likely to adopt pit sowing in the second year of the experiment. The results show that the silver-bullet influencer technique was the least effective; it had yet to result either in spreading knowledge or adoption. One technique that performed slightly better was the shotgun strategy. The best design, however, was the snowball. The methodological approach of this study entails high network data collection costs; targeting central farmers has many benefits for technology dissemination, but at the same time, studying and mapping the social network is expensive. A great solution to this problem of costs can be to conduct specific interviews, in which it is possible to identify the central individuals and then develop the network to trigger the dissemination process.

Another study about diffusion in agriculture that I analysed in the previous chapter is concerned with hybrid corn, a variety of corn obtained by crossing two lines to combine the best characteristics of both. This type of corn has been a real revolution in the agricultural sector because it has significantly increased corn production in the United States since the mid-1930s; it brought a relevant increase in the productivity of crops. Ryan and Gross conducted a study in two communities in Iowa, where 259 farmers were interviewed. What was asked of the farmers was related to where and how they learned about the new agricultural product and after how long from the knowledge of existence they adopted it. It came out that farmers took time to embrace the hybrid corn; even if they knew it, they wanted to see how the plant was growing to those who had already planted it. The farmers waited to trust it after learning about it but wanted to see if the benefits were real from their neighbours. The first adopters gradually gained confidence in the hybrid corn and increased the field cultivated with this product type yearly.

The earliest adopters performed a unique function for their communities in their roles as "experimenters"; this is proved by the fact that most of the respondents said that, thanks to the neighbour's experience were convinced of the validity of the product. Ryan and Gross sensed that the space of hybrid maise in Iowa communities was a social snowball; the more they talked about the product, the more knowledge it raised and then adoption. Farmers relied on the experience of each other to take advantage of the innovation.

In these experiments, we have therefore grasped that the most effective strategy is the snowball, in which seeds are taken that are centrally located in the social network. Social networks must be controlled to influence people's behaviour to limit damage to our planet and halt climate change. To begin with, there is a need to study how the relationships, whether weak or strong, between the individuals taken into consideration are organised. Next, change agents need to be selected and trained, and they need to be in a central position that allows for step-by-step dissemination throughout the network. In addition to disseminating the technology or ecological method, the selected individuals may be asked to educate others willing to adopt it.

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