Regenerative Agriculture: A Manual

eit Food

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A NOTE ON THE AUTHORS

This manual was funded by EIT Food and produced by The Regeneration Academy and TheRockGroup.

EIT Food is Europe's largest and most dynamic food innovation community. Supported by the EU's European Institute of Innovation and Technology (EIT), we invest in projects, organisations and individuals that share our goals for a healthy and sustainable food system – with a focus on education, entrepreneurship, engagement and innovation.

The Regeneration Academy is located on La Junquera regenerative farm in Murcia, Spain, where they give students and young entrepreneurs the skills and practical experience to become innovators in the fields of regenerative agriculture and ecosystem restoration.

TheRockGroup is a sustainability consultancy driving the transition to a sustainable society and economy through business development and education. Together, The Rock Group and Regeneration Academy develop business opportunities, share practical knowledge and provide a living example of what regenerative agriculture can achieve.

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This is the list of chapters of the Regenerative Agriculture Manual, which you can consult individually on our web site.

Welcome to the Regenerative Agriculture Revolution: Making the transition

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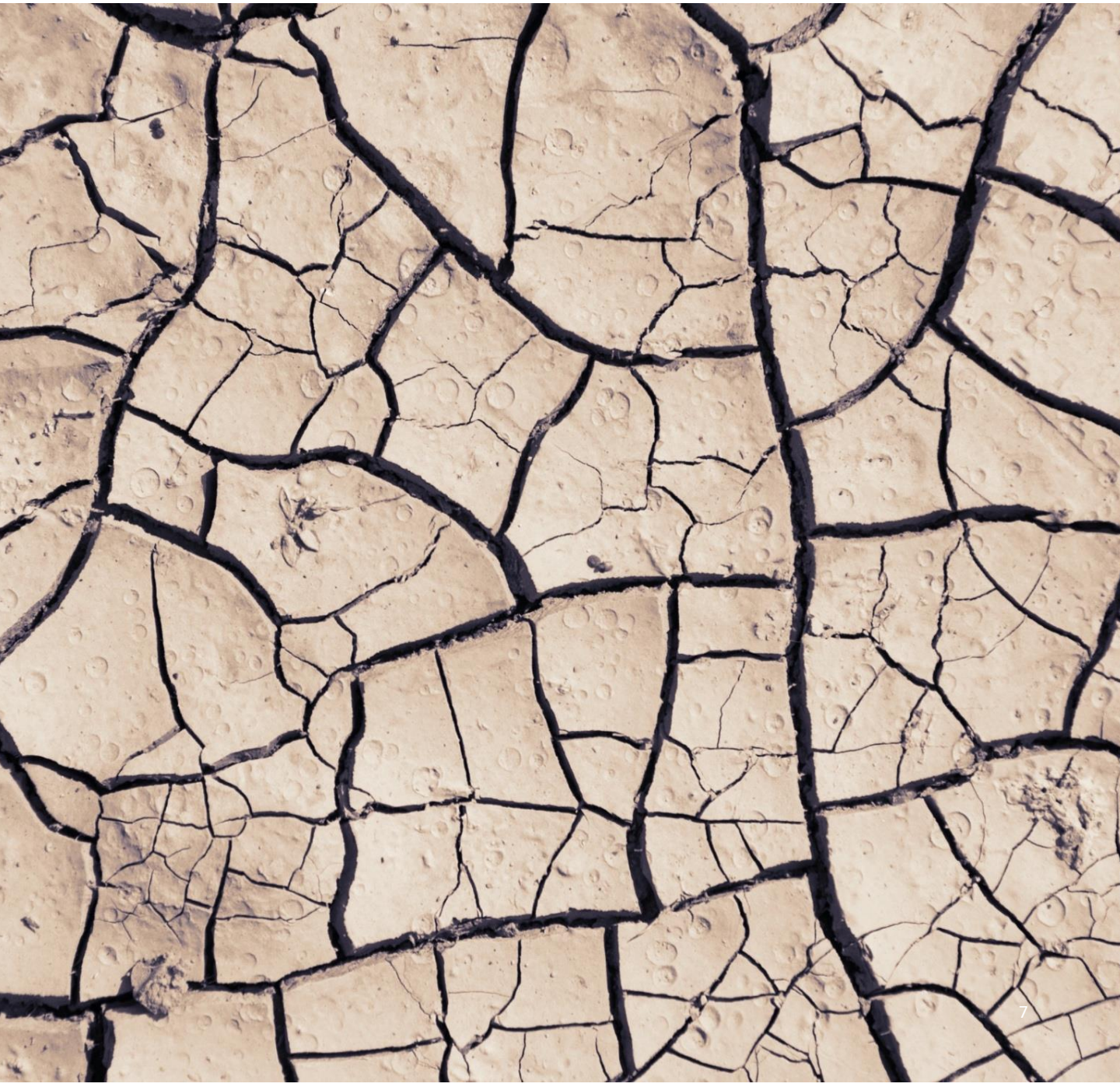
1.1. The story so far

As a farmer, you know it's not always an easy job – especially now that we're faced with the challenges of a changing climate, reduced biodiversity and the negative effects of chemicals on soil fertility. To understand how we can do things differently, let's start with a quick history lesson…

More than 10,000 years ago, our hunter-gatherer ancestors began farming for the first time. For thousands of years, this happened on a very small and primitive scale, as humans started to purposefully select and cultivate plants and animals. At this stage, human agriculture was just a footnote in the planet's broader natural ecosystems. But as successful food production helped the human population to grow, agriculture changed. Not only did humans practice agriculture on an ever-larger scale, but we became experts at exploiting and manipulating natural ecosystems for our own purposes. As a result, human farming began to change the landscape, environment and local climate.

Over the last two centuries, the human population has exploded. Not only that, but the way we practice agriculture as changed beyond recognition, with mechanization and technological advances helping us to drastically increase crop yield, with relatively little human labor. Freed from our ancestors' constant preoccupation of food production and basic survival, humans have been able to build the complex modern society we all enjoy today. As a farmer, you are central to that achievement.



But our environment has paid a heavy price: more than any other human activity, agriculture has changed our natural world. In the past few decades, we have come to understand how industrial-scale farming is jeopardizing our future, threatening the opportunities and living standards available to ourselves and our children.

That's why we need a new agricultural revolution: one which maintains productivity in a sustainable way, while offering a decent livelihood to farmers and their communities. Time is running out to protect our planet and our food supply. Our generation must transition to a form of agriculture that works with and within ecosystems, instead of disturbing and destroying them. With your help, we can do it.

THIS MANUAL

This manual is written for farmers who are ready to join the revolution. If you are committed to improving our agricultural system, these chapters will help you make the switch to regenerative practices - reducing risks and costs, while improving the productivity and resilience of the farm. It is a practical resource designed to support farmers as they transition, combining our knowledge with your expertise of your farm, land and context.

The manual is a living document and will be extended and deepened every year. As you begin your regenerative journey, we invite you to share your experience so we can include your expertise in the next edition. That way, farmers all over the Mediterranean can work together to change the way we farm, for good.

1.2.Farming Under Pressure

As our conventional agrisystem has grown, its focus has been on finding cheaper ways to produce more food to feed our growing population. As a result, farmers in Europe often receive prices for their products that don't even cover the costs of production, forcing them to rely on subsidies just to stay afloat.

Additionally, lots of Mediterranean farmers are seeing tangible changes to their farm. Production is declining; there are more pests and diseases; more fluctuating and extreme temperatures, heavy rain events and winds. Uncovered soil combined with occasional heavy rains is causing extreme erosion and loss of fertile soils. Further exacerbating the issue is deforestation, and the grazing and burning of land that has expanded deserts in the region. Water scarcity has been temporarily held at bay through irrigation, dams and use of drought-resistant crops; but as soil erodes, and over-irrigation makes it saline and unproductive, opportunities in agriculture in southern Europe are increasingly limited.

Farming has become incredibly costly to the environment - and to the farmer.

Not only that, but industrialised agriculture is leading to a collapse of the social fabric of rural communities. The life of a farmer has always meant hard work and high risk, but communities can see that things are getting worse. Over the last hundred years, rural poverty in the Mediterranean (caused by drought and erosion) has led to mass migration to the cities; this exodus only amplifies environmental issues as well as social and economic divides. For all these reasons, the Mediterranean is a priority region in tackling climate change and transforming the agrifood sector in Europe. F

arming systems and ecological systems are intrinsically linked, and that our human wellbeing depends on a sustainable relationship with the natural world. To future-proof our farms, we need to act on a systemic level – but we all have a part to play.

"For the last century, agriculture has prioritized increasing production, even as farmers' profits are squeezed. Regenerative agriculture lowers farmers' costs and regards profit as more important than production.

Simply put, if you produce the same output with half the input, you make more money. That financial saving is the most immediate effect seen by farmers who switch."

- Philip Fernandez, Agriculture Project Manager at EIT Food -

Natural Capital & Ecosystem Services

Natural Capital refers to the social and economic benefits we all get from a healthy ecosystem. For example, a wetland that filters fresh water, a healthy lake with plentiful fishing stock, the pollination of crops by bees, or clean, forest-filtered air. When maintained in a healthy balance, these natural stocks provide benefits and services that we all need for survival.

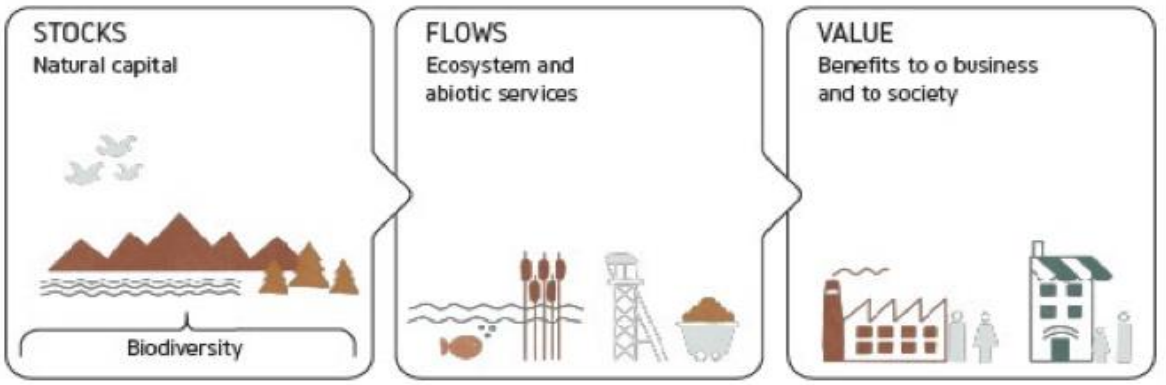


Image source: Natural Capital coalition

Unfortunately, in Europe, our natural capital and ecosystem services are under pressure.[(1)]

Threats to Natural Capital in Europe:

Soil Erosion

- Loss of soil: decarbonization and soil loss through surface erosion
- Hydrology: Low or no ground cover results in lower water uptake. Unsustainable use of water sources results in desertification and salinization
- Salinization: soils are becoming more saline
- Pollution of soil by herbicides, pesticides, and chemical fertilizers

1. https://www.eea.europa.eu/soer/2015/europe/natural-capital-and-ecosystem-services

Climate Change

Caused by:

- Direct and indirect emissions: manure, cattle, feed production
- Land change, tilling
- Loss of organic matter in soil reduces the ability of soil to sequester carbon

Biodiversity loss and ecosystem degradation

Caused by:

- Soil erosion and climate change
- Habitat destruction.
- Pollution: as a side effect of the use of herbicides, fertilizers and manure.

Greater occurrence of pests and plagues

- Monocultures are more vulnerable to the rapid spread of pests and plagues
- Degradation of ecosystems, soil and hydrology make crops and cattle more vulnerable to pests and diseases

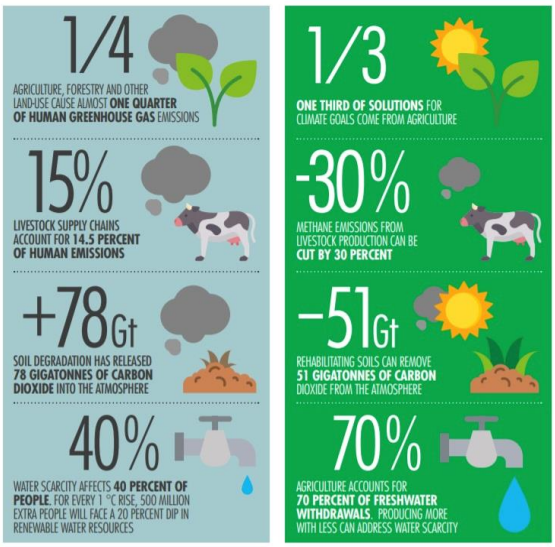
Land abandonment

- Decreasing opportunities to make a decent living
- Lack of facilities in rural areas
- Monocultures requiring few people and labour

The Economic Cost

Together, these issues pose a massive threat to health, food security and biodiversity worldwide. They are all interconnected, through complex interactions of chemical compounds, species and material and nutrient cycles cycles. But for now, let's take one example: Soil Erosion.

Although erosion is a world-wide problem, Mediterranean countries have an above-average risk for erosive events, flood events and water scarcity.[(2)] It is estimated that erosion in Europe costs between 4.80 € and 93.33€ per hectare and year (European Commission, 2006).



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The total cost of soil degradation in the EU is approximately 97 Billion € per year. Two-thirds of these are costs to human health.[(3)] According to the European Commission, land degradation in the Mediterranean threatens food security directly, as 30% of the semi-dry areas have already been affected by desertification. 52% of agricultural land is moderately or severely affected by soil degradation, with arable land loss estimated at 30 to 35 times the historical rate.[(4)]

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2 Panagos P, Borrelli P, Poesen J, Ballabio C, Lugato E et al. 2015 The new assessment of soil loss by water erosion in Europe. Environ. Sci. Policy 54, 438–447. doi: 10.1016/j.envsci.2015.08.012

3 https://clubofrome.org/wp-content/uploads/2020/10/System-Change-Compass-Full-report-FINAL.pdf

4 https://www.europarl.europa.eu/RegData/etudes/BRIE/2020/646171/EPRS_BRI(2020)646171_EN.pdf

1.3. What's it all about?
Understanding regenerative agriculture

Most agricultural systems can be categorized as one of the following: traditional agriculture, conventional agriculture, organic agriculture, conservation agriculture, and regenerative agriculture. Let's look at those in more detail:

1 Traditional Agriculture

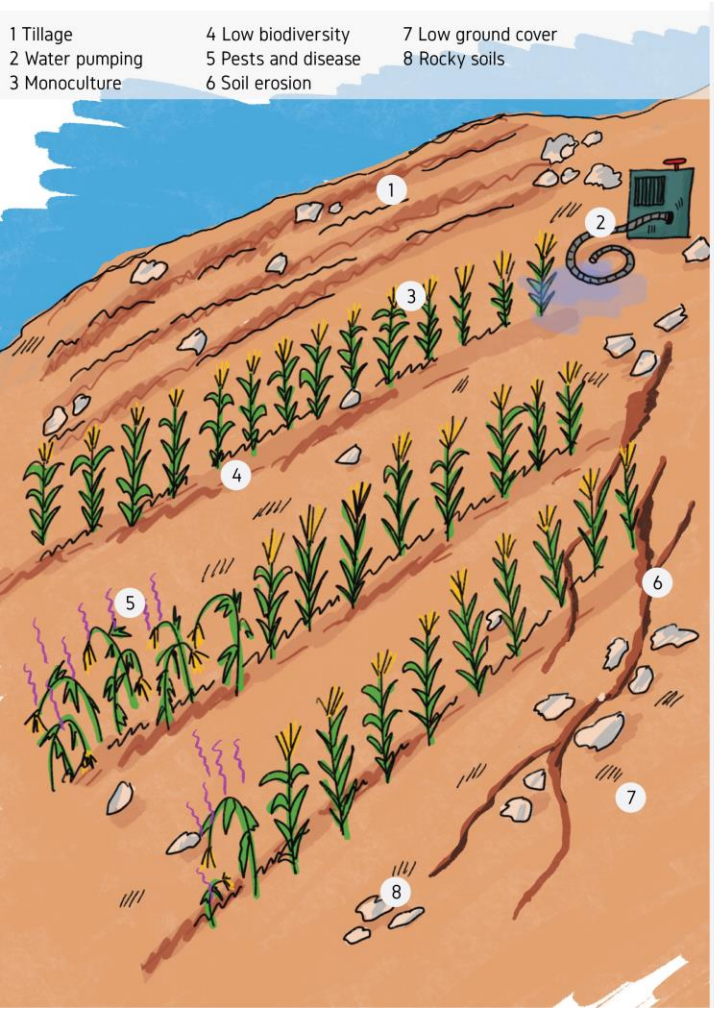
This system dominated for millennia, and essentially consists of different types of subsistence farming. In Europe, it no longer exists at scale.

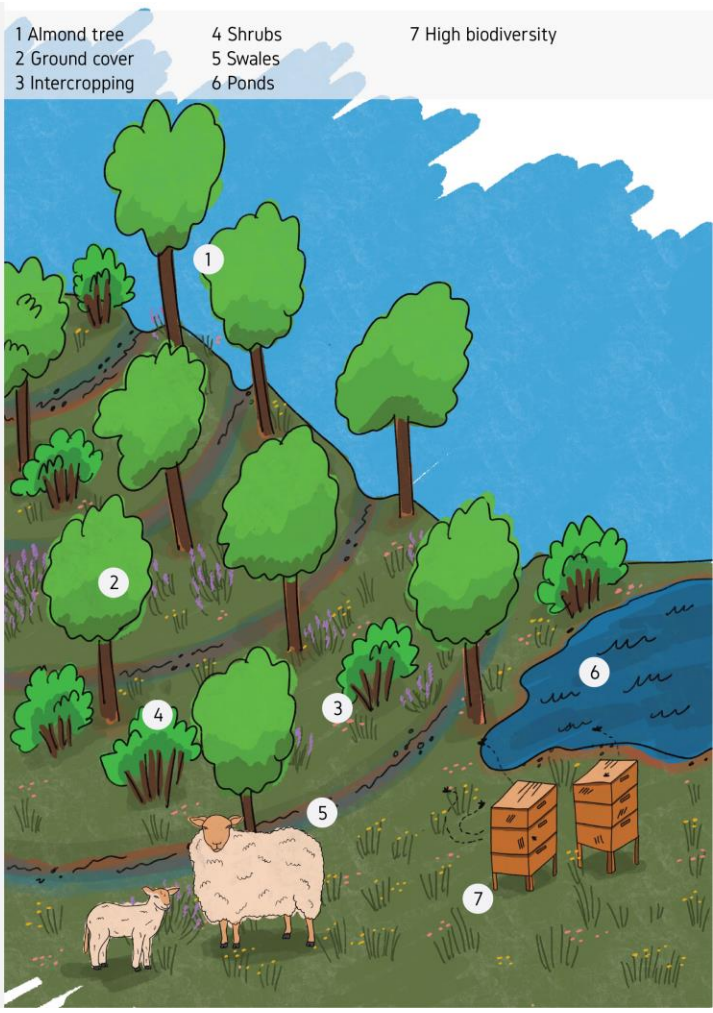
2 'Conventional' or Industrial Agriculture

This system was first developed in North-Western Europe and is less than two centuries old. In most of Spain's rain-fed agriculture areas, chemical fertilizers did not arrive until the 1960s. Conventional agriculture yields a significant crop output, but requires significant material inputs, including mineral fertilizers, herbicides and pesticides. These chemicals damage the soil organic matter and fertility, reduce biodiversity, increase CO2 emissions, and much more.

3 Organic Farming (also called Biological or Ecological Farming)

Organic farming is a system that does not use synthetic fertilizers, pesticides, growth regulators or livestock feed additives, in order to prevent pollution of the environment and the degradation of ecosystems. It aims to sustain or conserve, as opposed to regenerating the land. To maintain soil productivity and fertility and to control weeds and pests, organic farming relies primarily on crop rotations, crop residues, animal manure, legumes, green manure, and biological pest control. As an ecological production management system that promotes and enhances biodiversity, biological cycles and soil biological activity, organic farming can be part of a sustainable model.





4 Regenerative Agriculture

Unlike industrial farming, Regenerative Agriculture is aimed at continuously *restoring* rather than degrading the soil, improving the *sustainability* and *resilience* of ecosystems and bringing environmental and economic benefits to farmers, communities and nations. It's all about working with nature to support vital ecological processes and services like nutrient cycling, nitrogen fixation, natural regulation of pests, soil and water conservation, biodiversity conservation, and carbon sequestration. Regenerative agricultural systems produce not only food and fibre, but other ecosystem services as well.

Let's Compare:

Industrial farming methods have been feeding our world for decades, and although they are effective in providing food in the short term, they take a heavy toll on our health and environment. Some of the consequences of industrial farming include poor animal welfare, increased greenhouse gas emissions, large-scale deforestation, soil degradation and problems with water quantity and quality. In this way, conventional farms contribute to climate change, even as climate change threatens their very future.

Because of their similar priorities, regenerative farms are often also organic. But a purely organic system - though better than a conventional one - can still decrease biodiversity, soil fertility and water uptake. And while organic farms prioritize the conservation of soil life and biodiversity, they don't always bring the economic, material and social benefits that communities sorely need.

IPCC Measure	Traditional agriculture	Conventional agriculture (IPCC, 2019)	Organic agriculture (European Commission)	Regenerative agriculture (ROC, 2019)
Reduced fertilizer use	✓	✗	✓	✓
Increased crop diversification	✓	✗	✓	✓
Increasing the use of quality seeds	✗	✗	✓	✓
Promotion of low energy production systems	✓	✗	✗	✓
Avoiding burning of crop residues	✗	✗	✗	✓
Promotion of legumes in crop rotations	✗	✗	✗	✓
Increasing biodiversity	✗	✗	✗	✓
Integrated crop/ livestock	✓	✗	✗	✓

According to the Intergovernmental Panel on Climate Change (IPCC) [5] these adaptation/mitigation measures are crucial to ensuring resilience to future farming challenges.

Clearly, a fresh approach is needed: one that improves the earth's soil and water quality, increases biodiversity on the long term, considers the local context and sustains ecosystems and communities without eroding their standard of living. This is where regenerative agriculture comes in. Regenerative farming yields substantial production, helping farmers to earn a decent living without compromising our environment. And because it's all about working with nature, the way you manage your regenerative farm will depend on your farm's specific context: the crop, climate, soil and resources.

"Some see regenerative agriculture ***as farming more like the way it used to be*** *- before the shift to greater mechanization and chemical use in the 1950s and 1960s encouraged monocultures and ever-larger farms. But it's about* ***future-facing innovation*** *- learning how to farm more effectively based on science and the nature of your farm."*

- Philip Fernandez, Agriculture Project Manager at EIT Food -

5. http://https://www.ipcc.ch/pdf/assessmentreport/ar5/wg3/ipcc_wg3_ar5_full.pdf

In the Mediterranean, the key pillars of regenerative farming are:

Improving soil health

- Minimize tilling (to reduce soil disturbance and erosion by wind and rain).
- Plant vegetation strips and ground cover (to increase erosion control, increased infiltration, reduced evaporation).
- Compost (to increase fertility through nutrients, micro-organisms and oil organic matter content).
- Introduce perennials and other plants with vigorous root systems .

Improving water management

- Introduce swales (contour trenches).
- Introduce ponds (for water harvesting).
- Introduce sediment traps.
- Keyline or contour lines (to slow down run-off).
- Water infiltration capacity.

Biodiversity

- Practice intercropping.
- Integrate plants and animals.
- Implement crop rotation.
- Increase biodiversity and support natural pest management.
- Diversify the farm.
- Work towards reforestation and restoration of natural corridors.

Understanding your context

- Work with the land and the local climate in a holistic way to maximise yield and restore natural processes.
- At every stage of the journey, consider the entire, interconnected ecosystem – as well as the economic impact.

General principles of regenerative agriculture




Understanding your context	Improving soil quality and health	Improving water management	Biodiversity	Holistic decision making
There is no 'one size fits all'. Consider your own specific land, soil, climate, crops etc.	Minimum tilling (to minimize soil disturbance and erosion by wind and rain)	Use of swales (contour trenches for water retention and infiltration)	Intercropping	Take the entire ecological system into account when planning and making decisions
	Vegetation strips and ground cover (to reduce erosion and evaporation and increase infiltration)	Use of ponds (for water harvesting and biodiversity)	Integrate plants and animals	Balance economic, social and environmental considerations
	Compost (to increase soil fertility through nutrients, micro-organisms and oil organic matter content)	Keyline or contour lines (to slow down run-off)	Crop rotation	
	Plant more perennials and other plants with vigorous root systems		Support natural pest management	
			Diversify the farm	
			Reforest and restore natural corridors	

1.4 How regenerative agriculture can work for you

Regenerative agriculture can be the solution to the social, economic and environmental issues that Mediterranean farmers face:

ENVIRONMENTAL BENEFITS

Regenerative land management increases soil fertility, maximizes crop yields, makes food more nutritious, supports the absorption of CO2 and recovers biodiversity. All this makes for more resilient crops, as greater agrobiodiversity and healthier soils also increase resilience to disease, pests and weather instability. In addition, regenerative agriculture protects soils from salination (which often occurs from over-irrigation) and reduces run-off, erosion and water pollution. Additionally, natural pest management uses local predators rather than chemicals, protecting soil and water quality while providing a safe haven for beneficial pollinators.

SOCIAL BENEFITS

From a social perspective, regenerative agriculture supports local farming communities and stops land abandonment in a variety of ways. Intercropping, a common technique in regenerative agriculture, means a more labour-intensive harvest - which often provides jobs to the local community and discourages urban migration.

COMMERCIAL BENEFITS

From a commercial perspective, regeneratively farmed crops can command a higher price – enabling farmers to achieve a better income. This is partly because regeneratively farmed food can be healthier, better quality and more nutrient-dense than conventional alternatives.

The Four Returns

RETURN OF INSPIRATION

Giving people hope and a sense of purpose

RETURN OF SOCIAL CAPITAL

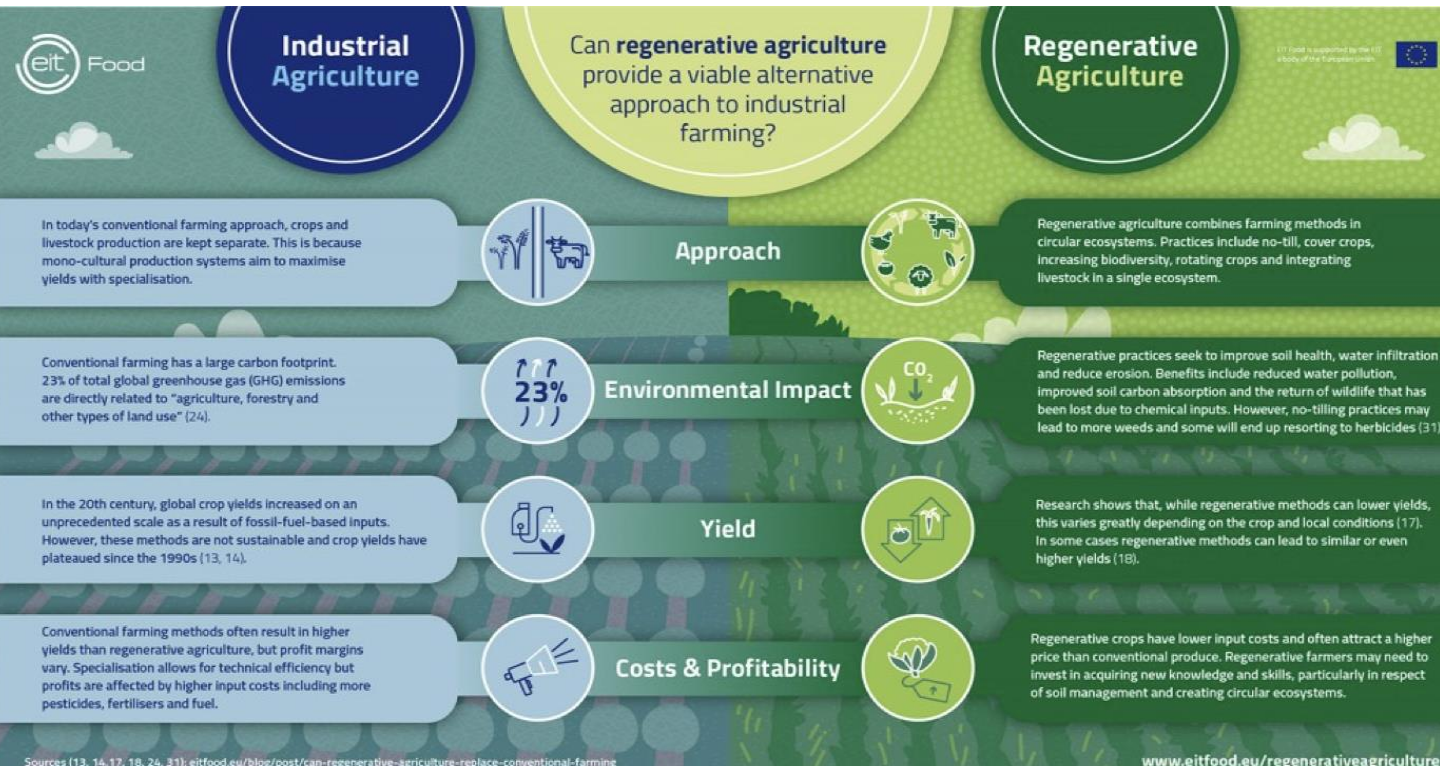
Bringing back jobs, business activity, education and security

RETURN OF NATURAL CAPITAL

Restoring biodiversity, soil and water quality

RETURN OF FINANCIAL CAPITAL

Realizing long-term sustainable profit



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