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FROM CARBON TO CREDIT:
REGENERATIVE AGRICULTURE AND CARBON CREDITS

TSKB DEVELOPMENT INSIGHTS

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Preface

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BECCS	Bioenergy with carbon capture and storage
CCUS	Carbon capture, utilisation and storage
DAC	Direct Air Capture
ETS	Emission Trading System
FAO	Food and Agricultural Organization of the United Nations
GHG	Greenhouse gas
ICVCM	Integrity Council for the Voluntary Carbon Market
IPCC	Intergovernmental Panel on Climate Change
SDG	Sustainable Development Goals
CBAM	Carbon Border Adjustment Mechanism
SOC	Soil organic carbon
SOM	Soil organic matter

Everblooming

More than two years ago, we wrote about "soil" in our quarterly Ecosystem Review and since then we have been keeping the "Good Earth" on top of our agenda.

During this period, we have asked a multitude of questions, sought answers and definitely learnt a great deal. Of course, it is not hard to build a consensus around the importance of soil, but what we are after goes beyond a verbal consensus. We strive for following a global agenda and tracking best practices so that we can build a detailed understanding while delivering solid policy recommendations.

Our stance when it comes to being "solid" is, we believe, important and distinctive. The link of this theme to structural reforms is at the heart of the matter here. I would consider myself fairly stable where I stand regarding formulating policies to trigger structural improvements. Let me reiterate what I wrote in my monthly periodical:[1] *We read many reports ending with a cliché and stating: we need to push for structural reforms. Yet we hardly see any report continue to explain what those reforms are… except for the reports by the TSKB Economic Research (not plugging our own work, but the truth!). Mandated to offer a development vision, my colleagues and I feel responsible for delivering solid, quantifiable policy recommendations. Some are easy, some are hard; some are not expensive, others are… Yet all are useful and doable, if you have the right macro and micro skills of planning.*

Indeed, this very report fits this aforementioned spirit of structural reform. In the report, my colleagues will explain the importance of soil and present the theme from an economist's point of view, pushing for low carbon development. Hence it will touch on a number of topics including ecosystem services, soil organic matter, regenerative agriculture, social capital and projects to support the earthquake zone.

Now you know what you will read. Let me also tell you what you will not read. You will not read clichés and a reiterating "soil is important" sentence that cannot be explained with numbers.

Instead, you will read details that inspired me to title this piece as "everblooming".

Soil is an everblooming theme that has the potential to trigger different but related reforms quite rapidly. These include some low hanging fruits with significant benefits in the short to long term, both for the overall economy but also for society. Here we set out the road map and ask for your hand in return, to walk this road side by side.

Burcu Ünüvar, PhD

Director – Chief Economist

[1] https://www.tskb.com.tr/uploads/file/yeni-ay-kasim2024-77.pdf

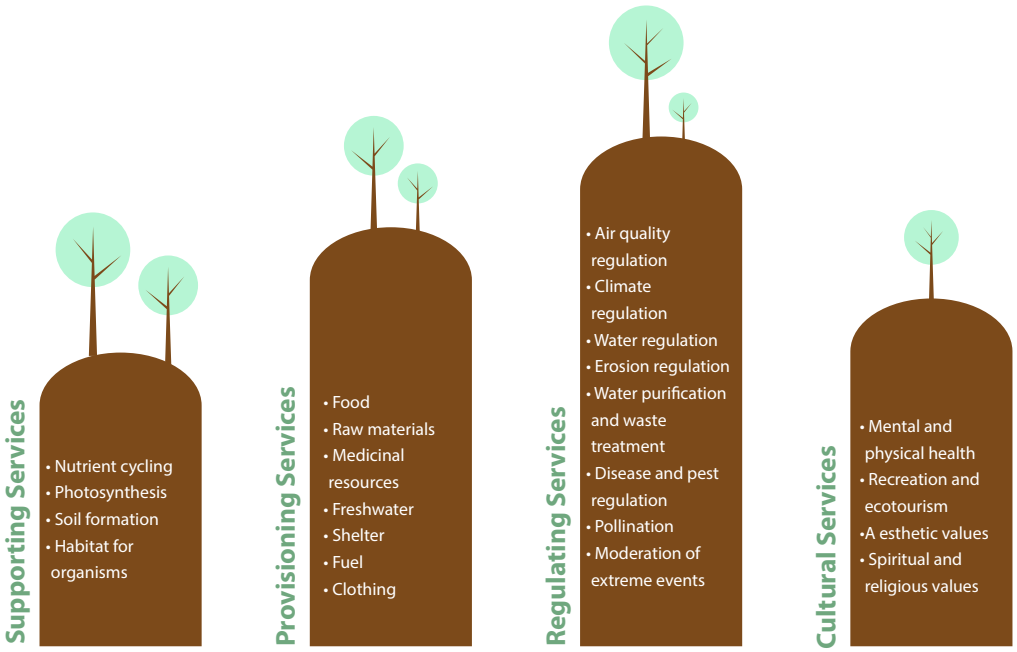
The Increasing Pressures on Soil

As an indispensable part of ecosystems, soil plays many important roles in the continuity of life on Earth and the wellbeing of humanity. As such, soil supports not only plants but also life. The degradation of soil due to the increasing pressures on it raises the need for us to take clear steps to prevent this. Before we move on to how this need can be met, let us take a closer look at the ecosystem services provided by soil in order to understand why soil is important.

Why Soil Matters

Soil provides a rich array of benefits for the ecosystem (Table 1). In this report, we address the main issues such as the role of soil in the nutrient cycle, which is one of the ecosystem's services, and the soil's contribution to the efforts to tackle climate change through its carbon capture capacity.

Table 1 Soil Ecosystem Services



Source: Pereira, Bogunovic, Muñoz-Rojas, & Brevik; Brevik et. al; FAO; Ecostandard; TSKB Economic Research

Nutrient cycle: One of the most important ecosystem services provided by soil is its role in the nutrient cycle. It is involved in the decomposition of soil organic matter (SOM), and then it supports plant growth by storing the essential nutrients released as a result of this process (Anikwe & Ife, 2023).

Water supply: Soil plays an important role in retaining water and making it available to plants. Soil health is therefore a prerequisite for plants to access the freshwater they need. When the health of the soil deteriorates, its water retention capacity decreases, paving the way for a greater likelihood of floods and water stress. This also presents a risk for food security.[2] Disruption to the water purification function of the soil may also result in groundwater contamination.

Biodiversity: Soil is home to a plethora of different organisms, from plants and fungi to bacteria and insects. These organisms living in the soil not only contribute to the food cycle, but also aid the soil structure, its water retention capacity and resilience. Protecting and strengthening this biodiversity is crucial for soil health and the functioning of ecosystems.

Carbon: From an ecosystem crisis perspective, one of the most important services provided by the soil for humanity is its capacity for carbon capture. Soil, which holds more carbon than the atmosphere and all vegetation combined, functions as the world's second largest carbon sink after the oceans (European Commission, 2011). In the absence of external interference, carbon can remain in the soil for millennia. However, a number of factors, particularly changes in land use, risk jeopardising the role of soil as a carbon sink.

Food, fuel & energy: Soil is an essential component of food and fuel production. Soil not only helps grow crops that are at the heart of the food system, but also enables the growth of crops such as sugar cane and maize for biofuels.

Ecosystem services provided by the soil are not limited to the those discussed here. They also include flood and erosion prevention, pest and disease control and cultural ecosystem services. (Pereira, Bogunovic, Muñoz-Rojas, & Brevik, 2018). When all these items are taken together, the economic value of the ecosystem services provided by soil is estimated to be USD 11.38 trillion according to a study published in 2017 (McBratney, Morgan, & Jarrett, 2017). This corresponds to approximately 14% of the world's GDP for the same reference period, demonstrating the extent of the economic contribution soil provides through its ecosystem services.

Why Has Soil Degraded?

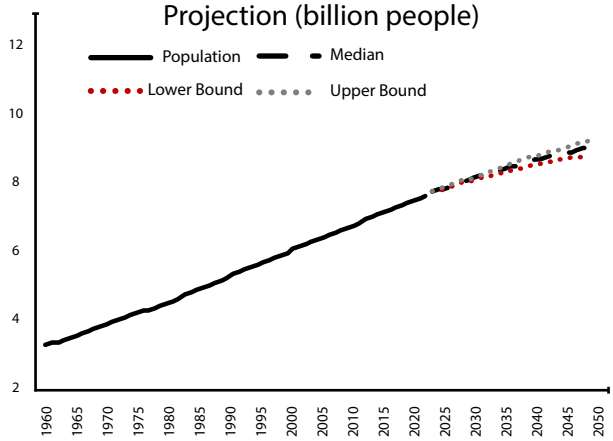
Soil is facing the threat of degradation as a result of daily pressures upon it. This is turn threatens the ecosystem services soil provides for us. The factors behind this degradation include deforestation, agricultural practices that damage the soil, rising populations, and urbanisation.

[2] Soils in the water cycle.
https://www.fao.org/soils-2015/news/news-detail/en/c/326283/

The first of these factors, deforestation, is closely related to other factors such as urbanisation and the expansion of agricultural land. According to the findings published by the Food and Agriculture Organisation of the United Nations (FAO), about 50% of global deforestation is caused by the expansion of agricultural land (FAO, 2022). The risk of erosion increases on land which has suffered from deforestation or where the vegetation has been damaged.[3] In addition to the negative effects of deforestation on soil health, soil degradation also exacerbates climate change, since the clearance of trees also releases the greenhouse gases (GHGs) which has been captured by them. Therefore, it is estimated that between 12% and 20% of global warming is caused by changes in land use (Heinrich Böll Stiftung, 2024).

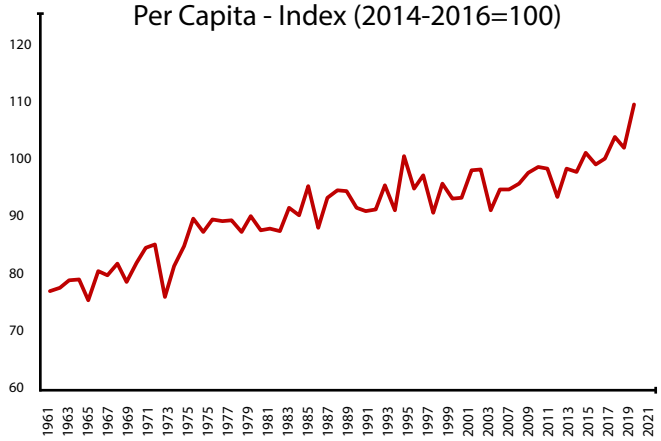
Population, another driving factor of land degradation, has been growing steadily over the years and now stands about three times higher than its level in the mid-twentieth century (Graph 1). This has also led to increase in food demand. Moreover, per capita agricultural production has demonstrated an upward trend both globally and in Türkiye over the years (Graph 2). When combined with urbanisation, it becomes apparent that the total share of agricultural land, which continues to expand at the expense of woodland, has been decreasing. All these factors leave us with an intensified agricultural production. However, the utilisation of increased soil tillage, along with the widespread use of chemical fertilisers and pesticides to increase yields for this purpose all put soil health at risk. These various practices risk compromising the capacity of the soil to hold water and organic matter, as well as undermining the biodiversity of the soil. These driving factors are likely to persist in the near future. For example, population growth, together with changing consumption patterns, are projected to lead to an increase of 50-70% in demand for food by 2050 (Pomeroy, Jose, Tyler, Bloxham, & Culling, 2023).

Graph 1 World Population and UN Population Projection (billion people)



Source: World Bank,United Nations Department of Economic and Social Affairs Population Division, TSKB Economic Research

Graph 2 Türkiye Agricultural Production Per Capita - Index (2014-2016=100)



Source: World Bank, TSKB Economic Research

These are not the only sources of the pressure on the soil. Human activity may also trigger natural processes such as wind and water caused erosion which damage the soil, while the climate crisis risks give rise to extreme weather events which could disrupt the structure of the soil. Soil is vulnerable to pollution from industrial activities and mining. However, rather than drive us to despair, these increasing pressures on the soil should lead us to reconsider our relationship with it. With the steps we will take, it is vital that we prevent further destruction of the soil and ensure the continuity of the ecosystem services provided by it.

[3] Soil Erosion and Degradation.
https://www.worldwildlife.org/threats/soil-erosion-and-degradation#:~:text=Deforestation,can actually worsen soil erosion.

Focus 1:
The State of Soil in Türkiye

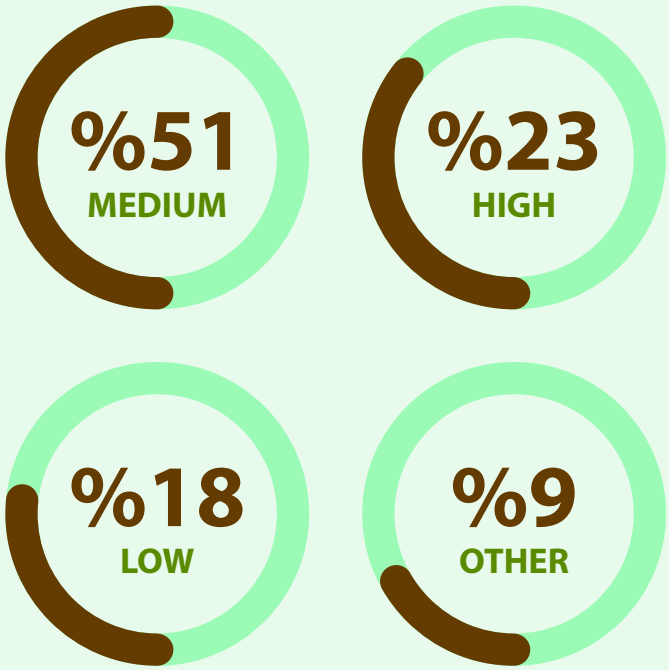
These pressures on soils are particularly pertinent for our country as well as our planet. Türkiye's soils suffer from various intertwined problems that negatively affect sustainability, agricultural productivity and the national economy. Erosion, which is one of our main problems, affects 59% of agricultural land, 64% of pasture and 54% of woodland. (ÇMUSEP, 2019). Loss of fertile upper layers of the soil through erosion leads to the loss of SOM[4] and reduces soil fertility. The use of chemical fertilisers has tended to increase in areas where fertility has decreased. In addition, the mixing of the top layer of soil, lost as a result of erosion, into water resources negatively affects water quality.

In addition to erosion, industrial agricultural activities, characterised by the use of fertilisers, pesticides and intensive use of machinery, which undermine soil health, also lead to a decrease in SOM. Thus, the soil's capacity to hold water and nutrients, as well as soil health and fertility, are reduced, adversely affecting food production. The SOM ratio may vary according to soil type. In sandy soils, this ratio can be below 1%; in loamy soils it would be in the order of 2-3%, while in clays it may exceed 4-5% (Magdoff & Van Es, 2021). In fertile agricultural soils, the SOM ratio is generally between 3-6%.[5] According to a study conducted by the Ministry of Environment, Urbanisation and Climate Change, the amount of organic matter is considered to be "very low" in a significant portion of Türkiye's soils with a SOM level between 0.5% and 6% throughout the country (ÇEM, 2018).

[4] Soil organic matter (SOM) is produced by living organisms such as plants and animals and returned to the soil through decomposition. These substances are critical for soil quality and the ecosystem services provided by the soil.
[5] Soil Organic Matter.
https://franklin.cce.cornell.edu/resources/soil-organic-matter-fact-sheet

Another important problem related to soil in Türkiye is desertification, which is defined as the decrease in soil biodiversity in arid and semi-arid areas due to natural causes and human activities. In terms of their vulnerability to desertification, currently 18% of the soils are at a low level of vulnerability, 50.9% are at a moderate level of vulnerability and 22.5% of the soils in Türkiye are considered to be of a high level of vulnerability to desertification (Graph 3).[6] Existing risks are also increasing with climate change. Rising temperatures and changing precipitation patterns are leading to drier conditions in some regions and heavy rainfall and erosion in others. In our country, which has struggled with the negative effects of salinisation, urbanisation and soil pollution in addition to these problems, soil should be addressed as a problem of today and not as one for the distant future.

Graph 3 Türkiye Desertification Vulnerability Classification



Source: General Directorate of Combating Desertification and Erosion, TSKB Economic Research

[6] Türkiye Desertification Model and Vulnerability Map. https://cem.csb.gov.tr/turkiye-collesme-modeli-ve-hassasiyet-haritasi-i-103686

One Step Forward: From Sustainability to Regeneration

Although sustainable approaches are a step in the right direction in alleviating the pressures on soil and protecting it from further destruction, these approaches may be insufficient when it comes to reversing the existing damage. This requires us to go one step further than sustainability and adopt a regenerative perspective in our relationship with the soil. *Regenerative agriculture* serves an important purpose within this perspective. However, there is no single agreed upon definition of this concept. Despite the various concepts and priorities in different definitions, most definitions meet common goals such as ecosystem restoration and soil health.

What Is Regenerative Agriculture?

The Rodale Institute introduced the concept of "regenerative agriculture" in the 1980s for an understanding of agriculture beyond sustainability. The institute points to soil health as the first priority of regenerative agriculture. In this vein, it prioritises an understanding that " improves the resources it uses, rather than destroying or depleting them " (Rodale Institute). Kiss The Ground, another leading organisation in the field of regenerative agriculture, adds biodiversity and increasing the productivity of the land to soil health in its focus on regenerative agriculture.[7] The Intergovernmental Panel on Climate Change (IPCC) considers regenerative agriculture to be a "sustainable land management practice". It emphasises that practices within this scope could increase the resilience of agricultural ecosystems (IPCC, 2019). Regeneration International, on the other hand, broadens its focus to emphasise the impact of regenerative systems to improve the environment, soil, plants, animal welfare, health and communities.[8] Under this definition, practices such as the use of harmful pesticides and the clearing of valuable ecosystems, as well as exploitative pricing and marketing systems, are considered "degenerative".

Inspired by all these perspectives, in this study we refer to regenerative agriculture as "agricultural practices that increase soil biodiversity and the amount of carbon captured in the soil, and which restore the ecosystem to health by rebuilding soil organic matter". These practices include reduced soil cultivation and cover crops (Table 2). In addition, practices such as crop rotation and agroforestry are also considered within this scope. So how do regenerative agricultural practices deliver its promised benefits?

[7] Guide to Regenerative Agriculture. https://kisstheground.com/education/resources/regenerative-agriculture/
[8] The Definition of Regenerative Agriculture. https://regenerationinternational.org/2023/12/22/the-definition-of-regenerative-agriculture/

Table 2 Selected Regenerative Agriculture Practices

Regenerative Agriculture Practices:	Description:
Reduced tillage (or no-till agriculture)	Reducing the area, frequency, or intensity of tillage.
Cover crops	Plants planted to cover the soil between main harvest seasons to not to leave the soil empty.
Crop rotation	Planting various crops in a planned sequence on agricultural land.
Agroforestry	Growing trees and shrubs alongside crops on agricultural land.
Mulching	Covering the soil surface with organic materials such as leaves, branches, and harvest residues.
Intercropping	Simultaneous growing of crops on the same agricultural land.

Source: TSKB Economic Research

Impacts of Regenerative Agriculture

Quality: One of the main benefits promised by regenerative agricultural practices is the improvement of soil quality. For example, reduced till, which is based on reducing the extent of soil disturbance, and planting cover crops instead of leaving agricultural land empty between the main harvest periods can increase the amount of water retained by the soil (SARE, 2019). These practices also reduce the risk of soil erosion.[9] This also prevents the loss of the top layer of the soil, which stores the nutrients necessary for plant growth.

[9] Saving Money, Time and Soil: The Economics of No-Till Farming
https://www.usda.gov/media/blog/2017/11/30/saving-money-time-and-soil-economics-no-till-farming

Carbon capture capacity: One of the most important benefits of regenerative agricultural practices in tackling the ecosystem crisis, in addition to their contribution to soil quality, is that they help increase the soil's capacity to capture carbon. Although this capacity may vary depending on factors such as soil and climate conditions and how the soil is managed, research shows that regenerative agricultural practices offer promising results in mitigating climate change. A paper analysing the results of 658 studies for seven different regenerative agricultural practices found that all practices increased carbon capture in the soil, with the impact increasing further when the practices were combined (Villat & Nicholas, 2024).

Biodiversity: When compared to conventional agricultural practices, regenerative agriculture offers significant contributions to biodiversity as it adopts practices that prioritise the convergence of ecosystems to their natural state. In addition to cover crops, practices such as agroforestry, i.e. planting trees and shrubs along with crops on agricultural land, also improve soil biodiversity. The practice of agroforestry also enables the establishment of symbiotic relationships between trees and plants grown in the region.[10]

Yield and Profit: Despite all the benefits promised by regenerative agriculture, one of the requirements for its wide-scale implementation is that the farmers who will implement these practices do not suffer a downturn in their income. One frequently cited concern is that the adoption of regenerative agriculture may reduce agricultural yields, by moving away from practices such as chemical fertilisers and pesticides which are harmful to soil health.

Studies examining the effects of regenerative agricultural practices on yields also find that the effect on yield is not necessarily negative, and even when it is, the impact may not be long-term. For example, a study conducted by the Farm Carbon Toolkit notes that the change in yields after reductions in soil till may vary between farms. According to the study, most farmers report an initial decline in yields, before yields return to their long-term average after a period of about five years. On the other hand, other regenerative agricultural practices such as intercropping appear to have a positive impact on yields (Bowles, 2024). Another study finds that soil organic carbon (SOC) may be increased in humid regions without loss of yield. (Jordon et al., 2022). This reveals that in order to obtain the desired results from regenerative agriculture, the practices implemented should be designed to be compatible with the climate and soil structure of the region.

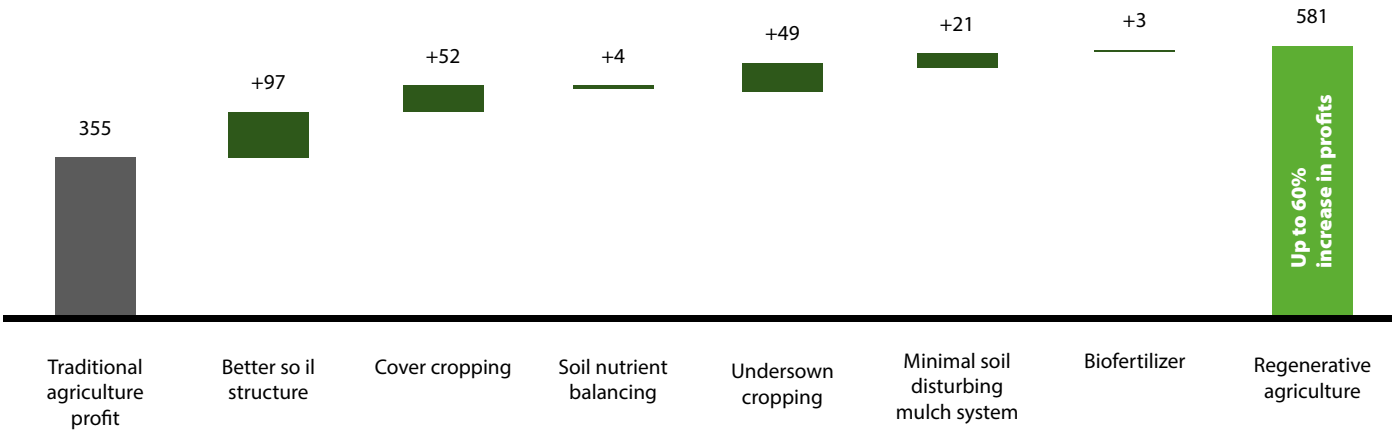
[10] Agroforestry – what are the benefits? https://www.soilassociation.org/causes-campaigns/agroforestry/agroforestry-what-are-the-benefits/

In addition to yield, it is also important to address the impact of regenerative agricultural practices on farmers' costs and the timeframe in which this impact would be felt. For example, while some regenerative agricultural practices, such as reduced till, require less labour than traditional industrial agricultural practices, other practices, such as mulching, which involves covering the top layer of the soil with plant material, require more labour and time, which can lead to an increase in labour costs. (Africa Regenerative Agriculture Study Group, 2021). Another study analysing the effects of regenerative agricultural practices in maize production found that these practices reduced yields by 29% compared to industrial farming practices. However, the researchers note that regenerative agriculture paves the way for a 78% increase in profit when compared to industrial agriculture, thanks to an improvement of SOM levels and biodiversity while reducing fertiliser and pesticide expenses. In addition, it is noted that farms implementing regenerative agricultural practices are able to market their products in different ways and diversify their income streams, for example by using cover crops for grazing animals (LaCanne & Lundgren, 2018).

A study from the US, estimates that the transition period following the implementation of regenerative agricultural practices may last for 3 to 5 years. During this period reduced yields and increased costs may result in a decline of USD 15-45 in annual income per decare. In the long term, it is estimated that the transition to regenerative agriculture would a provide 15-25% return on investment (Boston Consulting Group, 2023). A similar study conducted in Germany estimates that farmers' profits could increase by at least 60% after a 6-year transition period. According to these calculations, improving soil structure (Graph 4) would account for the greatest increase in profit per hectare per year. The benefits of regenerative agricultural practices are not limited to farmers who adopt them. In a scenario, where basic practices such as reduced till and cover crops are adopted by 80-100% of farms by 2035, intermediate practices by 50-75% of farms and advanced practices by 15-25% of farms, regenerative agriculture could deliver socio-ecological benefits worth an annual EUR 8.5 billion in Germany. (Boston Consulting Group, 2023). It is emphasised that the benefits for the country and the planet could exceed this estimate based on reduced emissions and increased water availability.

Graph 4 Regenerative Agriculture Practices Annual Profit Forecast*
(euro/hectare)

* Profit forecasts are for after a stable implamentation stage is established, typically after 6-10 years after regenerative agricultural practices are first implemented.



Source: Boston Consulting Group, TSKB Economic Research

Social and community impacts: Another aspect that needs to be assessed regarding the feasibility of implementing regenerative agriculture practices is how these practices will affect consumers and society. As the German example demonstrates, the benefits of these practices are not limited to the farms that implement these practices. The benefits that reach beyond the farms themselves include benefits such as soil health and water quality. In addition, the avoidance of harmful chemical pesticides and fertilisers in regenerative agriculture practices could pave the way for significant benefits for consumer health.

Regenerative agriculture may also provide new employment in areas which require specialised knowledge, such as agroforestry.[11] Accordingly, sustainable jobs could be created in rural areas, allowing the creation of a structure which could encourage young people to embrace agriculture.

Food security is undoubtedly one of the issues we need to address when analysing the impacts of regenerative agriculture that reaches beyond the farm. In today's world, where problems surrounding food security have worsened in the wake of the Covid-19 outbreak, can food systems cope with the decline in yields during the transition period, necessitated by regenerative agriculture practices? At this point, it is important to point out that food security problems are not merely a problem of production but instead a problem of consumption and distribution. While between 8.9% and 9.4% of the World's population struggles with hunger, one-fifth of the food produced globally is lost or wasted (FAO, 2024; UNEP, 2024). This is a significant problem not only because it wastes precious resources such as water and agricultural land, but also because of the resulting additional GHG emissions. Adopting an approach to increase production at all costs without solving this problem leads to more careless use of soil and damage to soil health and ecosystem services provided by soil. For this reason, efforts to improve soil health could offset possible yield losses in the short term with steps to be taken against food waste. Supporting regenerative agriculture with waste management could offer environmental, social and economic benefits while improving soil health would also lead to gains in food security in the medium-long term.

A comprehensive review of regenerative agriculture practices finds that after a transition period, during which time farmers will see an improvement in soil health, the positive impacts of regenerative agriculture on profits, food security, food inflation and ecosystem services will be felt. However, the differences between the results of the studies also demonstrate the importance of tailoring these practices in accordance with the conditions of the locations where they will be implemented. Also considering the social impacts of these practices, it becomes clear that a regenerative agriculture structure should be designed that takes account of the interests of all aspects from the farmers to consumers and from the soil to the ecosystem.

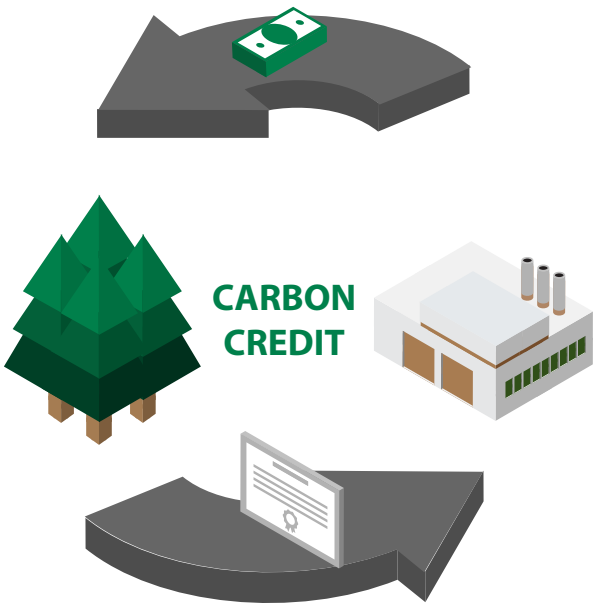
[11] Social and Economic Impact of Regenerative Agriculture https://inheritedseeds.com/blogs/news/regenerative-agriculture-8-social-and-economic-impact-of-regenerative- agriculture?srsltid=AfmBOorHcKVJDY2aykL4O1BjpkXrL5z5CzV23JCfHfBm4S0fAtuoNT0C

A Commercial Approach to Regenerative Agriculture from a Development Perspective: Carbon Credits

In this section, we consider the commercial structure needed to ensure a regenerative agriculture system that works well for both people and the wider ecosystem. A mechanism to enable farmers to adopt these practices without facing a loss of income is vital. We noted in the previous section that a business that adopts regenerative agriculture will offer a multitude of benefits in tackling the ecosystem crisis. Among these benefits, increasing the carbon storage capability of the soil is of particular importance, since the stored carbon can be converted into carbon credits and turned into a commodity sold in international markets. Before we address the challenges and opportunities offered by this process, we should provide the basic distinctions regarding carbon credits.

Sources of Voluntary Carbon Credits

Carbon pricing mechanisms come under three general categories: the Emissions Trading System (ETS), carbon tax and carbon credits. As of April 2024, a total of 36 ETS applications were in place worldwide, while it is reported that 22 ETSs are in the planning phase (ICAP, 2024). The European Union (EU) ETS, which is one of the most well-known examples of these practices, is a regulation-based structure (meaning there is an obligation to comply with), and has been implemented within the EU since 2005. Under the European Green Deal, trading partners will be required to meet the requirements of this regulation, directly or indirectly, in the form of the Carbon Border Adjustment Mechanism (CBAM). We are aware that preparations for a similar structure are underway in Türkiye, and are planned to be gradually rolled out after the Climate Law is adopted by the parliament. Also coming under the heading of obligatory compliance, the carbon tax is a direct tax on GHG emissions. The ETSs and carbon credits cover around 24% of GHG emissions with a total of 75 applications; it is estimated that this rate may approach 30% with the implementation of all the planned applications. (The World Bank, 2024). In this report, our main focus will be on the third pricing mechanism: carbon credits.



Carbon credit markets are based on the creation of a carbon credit by those who voluntarily reduce GHG emissions in return for emission reductions, with a carbon credit equivalent to 1 tonne of carbon dioxide. Income is generated by selling the generated carbon credit. The purchaser uses this carbon credit to offset the GHG emissions caused in their field of activity. When carbon credit trading takes place, there is a transfer of income from the actor responsible for the GHG emissions to the actor reducing GHG emissions. This additional income is expected to increase the motivation of carbon credit generating actors to reduce emissions. As expected, the system does not run smoothly; we will address the flaws and criticisms in the next section.

Carbon credits are differentiated according to how they are created and their impact on the amount of GHGs in the atmosphere (Table 3). For example, a "technology-based" carbon credit created through a project that prevents the release of carbon from the burning of fossil fuels is considered as an "Avoidance Credit" (from the increase in carbon in the atmosphere). Carbon credits, generated by “Direct Air Capture” (DAC) technology and are referred to as "Reduction Credits" since they reduce the amount of carbon in the atmosphere.

Table 3 Some of the Sources of Voluntary Carbon Credits*

Technology-based: description	TECHNOLOGY-BASED	Credit type	NATURE-BASED	Nature-based: description
Capture of carbon generated by the use of fossil fuels, biomass production or industrial facilities.	**Carbon Capture, Utilisation and Storage (CCUS)**	**AVOIDANCE CREDITS**	**Combating Deforestation**	Deforestation releases carbon stored in the trees. Combatting deforestation prevents the release of stored carbon.
Combining bioenergy and carbon capture.	**Bioenergy with Carbon Capture and Storage (BECCS)**	**REDUCTION CREDITS**	**Afforestation**	Increases the amount of carbon stored in forests.
Sequestering carbon directly from the air, regardless of where carbon emissions were created.	**Direct Air Capture (DAC)**	**REDUCTION CREDITS**	**Regenerative Agriculture**	Increases the amount of carbon stored in soil.

* Carbon credits in addition to those listed here can also be issued to reduce a household's environmental footprint and avoid greenhouse gas emissions through the use of renewable energy.

Source: TSKB Economic Research

This dichotomy is important for companies. While Avoidance Credits have a relatively low price, they are used by companies which have pledged a commitment to carbon neutrality. On the other hand, companies with a net-zero commitment use Reduction Credits, which come with a higher unit price. As seen in the table, regenerative agricultural practices are a "nature-based" Reduction Credit, to the extent that they increase the amount of carbon stored in the soil. In addition, we should also note that there is also an "Avoidance Credit" element due to the lower level of soil cultivation and lower use of chemical fertiliser.

Bumpy Way Ahead

Carbon credits could serve as an important tool in closing the financing gap in the efforts to tackle the ecosystem crisis and providing an inflow of resources to developing countries. However, there is a need for highly reliable, verifiable, traceable and standardised structure for the carbon credits produced. It has been more than two years since we first addressed the issue[12]. As we said then, there have been many bumps in the road. As a matter of fact, despite the progress achieved in the development of carbon credit markets recently, a number of high-profile incidents have shaken confidence in the market. [13]

The volatility in the carbon credit market has also mobilised a search for "high quality" credits. For example, in an effort to raise the quality bar, the Integrity Council for the Voluntary Carbon Market (ICVCM), decided against labelling carbon credits based on existing renewable energy methodologies as compliant with the Core Carbon Principles[14]. These credits account for about one third of the total voluntary carbon market volume. The announcement is a signal that will lead to a decline in the share of low-quality carbon credits in the market.

Companies are also stepping up their search for quality carbon credits. Google's declaration that it has been carbon neutral by using "Avoidance Credits" since 2007 is an important example of this. It stopped making this claim from 2023, instead pledging its commitment to be "net zero" by 2030 by using "Reduction Credits".[15]

Although carbon credits have been subjected to justified criticism in many respects, they are considered as a structure that could close the financing gap in the efforts to tackle the ecosystem crisis. Ajay Banga, the President of the World Bank, reflected that the carbon credit markets, which have been under development for 20 years, are now in the final stages of achieving a transparent structure . Therefore, both regulators and companies are supporting the evolution of the market structure towards higher quality and reliable carbon credits. We can expect this trend to continue going forward.

[12] Building Voluntary Carbon Markets Step by Step on a Bumpy Road
https://www.tskb.com.tr/blog/surdurulebilirlik/gonullu-karbon-piyasalari-engebeli-yolda-adim-adim-insa-ediliyor
[13] As an example: Carbon Offset Market Faces Chaos as African Mega-Project Collapses
https://www.bloomberg.com/news/articles/2023-10-27/shaky-zimbabwe-project-puts-whole-carbon-market-at-risk?sref=jjXJRDFv
[14] Carbon credits from current renewable energy methodologies will not receive high-integrity CCP® labelling
https://icvcm.org/carbon-credits-from-current-renewable-energy-methodologies-will-not-receive-high-integrity-ccp-label/
[15] Google Is No Longer Claiming to Be Carbon Neutral
https://www.bloomberg.com/news/articles/2024-07-08/google-is-no-longer-claiming-to-be-carbon-neutral?sref=jjXJRDFv

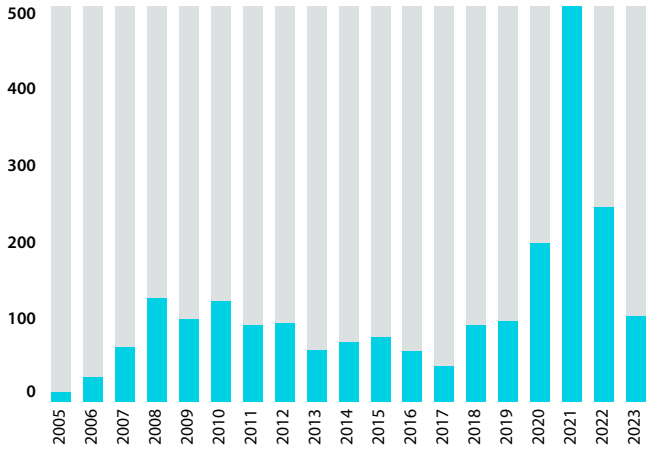
Market Size: Then and Now

The total volume of the carbon credits market has declined considerably in recent years. Examples of unrealistic or excessive declarations of credits produced to combat deforestation have significantly damaged the credibility of these credits. On the other hand, the debate on whether renewable energy credits offer additionality to emission reductions has also raised doubts about the reliability of carbon credits. Thus, carbon credits decreased from an annual level of 516 million tonnes of carbon equivalent in 2021 to a total of 111 million tonnes in 2023, approximately the same level as in 2019 (Graph 5).

Nevertheless, the development of the market should not be analysed only in terms of the total carbon credits generated. As a matter of fact, there is a significant differentiation in the composition of these credits. While 245 million tonnes of carbon equivalent credits were generated by forestry and land use projects in 2021, this figure declined to 36 million tonnes in 2023 (from 47% to 32.6%). A similar pace of decline is also seen in renewable energy projects. While the renewable energy projects had a 41.5% share of total carbon credits in 2021, this share decreased to 25.8% in 2023. From this perspective, it becomes apparent that the composition of the carbon credits market has changed after criticism and the erosion of confidence in the market, with a shift towards quality carbon credits.

Though different forecasts arrive at varying results, generally it is expected that the carbon credit markets will continue on a path of strong growth. Scenarios published by BloombergNEF (BNEF) in 2024 suggest that the market size for carbon credits could reach between USD 34 billion and USD 1.1 trillion by 2050. The wide gap between the scenarios is largely due to uncertainties regarding prices. For example, the voluntary market scenario foresees a carbon price of USD 14 in 2050, while in the high quality scenario foresees a price of USD 238. [17]

Graph 5 Total Carbon Credits (million tonnes carbon equivalent)



Source: Ecosystem MarketPlace, TSKB Economic Research

[16] Remarks by World Bank Group President Ajay Banga at the 2023 Annual Meetings Plenary
https://www.worldbank.org/en/news/speech/2023/10/13/remarks-by-world-bank-group-president-ajay-banga-at-the-2023-annual-meetings-plenary
[17] Carbon Credits Face Biggest Test Yet, Could Reach $238/Ton in 2050, According to BloombergNEF Report
https://about.bnef.com/blog/carbon-credits-face-biggest-test-yet-could-reach-238-ton-in-2050-according-to-bloombergnef-report/#:~:text=In%20BNEF's%20High%2Dquality%20scenario%2C%20prices%20are%20low%20in%20early,valued%20at%20%241.1%20trillion%20annually

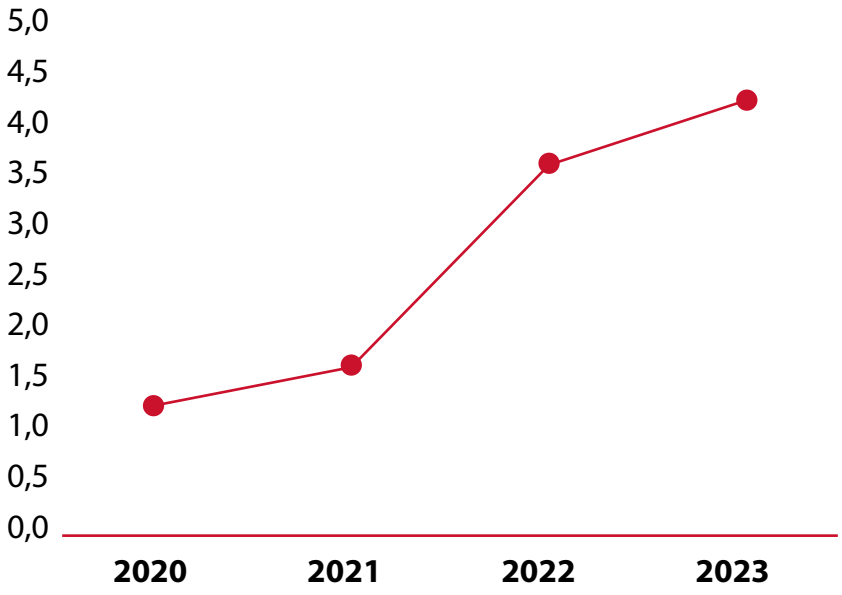
Carbon Credits from Agricultural Projects

While carbon credit markets underwent this restructuring and composition change, agricultural projects stood out positively from the rest, and credits generated by agricultural projects continued to rise with an average annual increase of 118.5% during this period (Graph 6), increasing their market share to over 4% by 2022. Despite a significant contraction in the overall carbon credit markets, it is noteworthy that credits originating from agricultural projects continued to rise.

But how far can this rise go? The BNEF estimates that the credits that could be generated by farming methods that store atmospheric carbon in soil and vegetation, i.e. carbon farming, could reach USD 13.7 billion in 2050 . Another study published this year in Nature calculates that the market could reach USD 375 billion by 2050[18] (Frank et al., 2024). The study suggests that storing carbon in the soil could have a positive impact of 0.6% on global output by supporting the economy-wide drive to reduce emissions.

The inclusion of carbon farming in the regulations of the European Union[19] and the United States[20] can be seen as important steps to support the formation and development of the market. In short, while there is a shift in the composition of the sources of carbon credits, efforts to develop carbon farming-like credits based on regenerative agriculture are gaining pace.

Graph 6 Agriculture Based Carbon Credits (carbon tonne equivalent)



Source: Ecosystem MarketPlace, TSKB Economic Research

[18] Unlocking Agricultural Carbon Market Opportunities https://about.bnef.com/blog/unlocking-agricultural-carbon-market-opportunities/
[19] Carbon Removals and Carbon Farming https://climate.ec.europa.eu/eu-action/carbon-removals-and-carbon-farming_en
[20] Biden-Harris Administration Announces New Principles for High-Integrity Voluntary Carbon Markets https://www.whitehouse.gov/briefing-room/statements-releases/2024/05/28/fact-sheet-biden-harris-administration-announces-new-principles-for-high-integrity-voluntary-carbon-markets/

Carbon by Indigo is a large regenerative agriculture carbon credit producer. So far, Indigo has produced a total of 300,000 tonnes of carbon equivalent credits in 3 carbon harvests. What is remarkable is the price of the company's regenerative agriculture-based carbon credits. The price, which was USD 20 in the first harvest, increased even further in the two subsequent export batches, reaching USD 60-80[21]. Given that this figure is USD 3.88 for credits of renewable energy-based projects and USD 6.51 for agricultural projects according to Ecosystem Market Place figures, it becomes clear how high the Indigo issuance sum is. An example of the orientation of companies towards quality carbon credits is seen in the sale made by Indigo. Microsoft announced that it is supporting the development of regenerative agriculture practices, having purchased 40,000 carbon credits generated by Indigo[22].

Another component of the quality of carbon credits is the co-benefit generated by the activity for which the credit is generated. Regenerative agricultural practices contribute to air and water filtration, erosion control and seed dispersal, as mentioned earlier in our study. They support the continued provision of healthy ecosystem services and food security. The co-benefits of regenerative agricultural practices, which directly contribute to many Sustainable Development Goals, in addition to carbon storage, ensure the relatively high quality of the carbon credits.

Where Do We Go From Here?

As in any market, the market for carbon credits from regenerative agriculture consists of a seller (credit producer) and a buyer. In this market, the seller is the farmer who makes their agricultural practices regenerative. So how do farmers view regenerative agriculture?

One study highlights that environmental co-benefits and the positive impact on long term sustainability of farms are among the factors motivating farmers to adopt regenerative agriculture (Barbato & Strong, 2023). It is noteworthy that the study emphasises that the income from carbon credits does not generate motivation. The study, which was conducted in the USA, also evaluates the reasons why farmers do not favour carbon credits based on regenerative agriculture. Farmers cite low payments, a high administrative and operational burden and a structure that favours large farms as reasons for their reluctance. Of course, there are many differences between American farmers and Turkish farmers. However, it would still be instructive to take these considerations into account when planning the development of a regenerative agriculture based carbon credits.



[21] Can regenerative agriculture build meaningful amounts of carbon in the soil?
https://www.indigoag.com/blog/can-regenerative-agriculture-build-meaningful-amounts-of-carbon-in-the-soil
[22] Microsoft Purchases Carbon Credits Helping U.S. Farmers Adopt Sustainable Agriculture Practices
https://www.esgtoday.com/microsoft-adds-regenerative-agriculture-carbon-credits-to-climate-portfolio/

In order for the market to function, the product - carbon credits - must first be standardised, and for this reason, a Monitoring-Reporting-Verification (MRV) system must be established. With the widespread use of carbon farming and the opportunities offered by digital technologies, it is possible to monitor the activities of companies in this field.

When it comes to the recipient of the credit, three different structures can be configured. Under one such structure, an intermediary firm could be involved in transactions between farmers and credit purchases. In this model, the intermediary would provide farmers with organisational support in the production of standardised carbon credits, and ensure the credits produced are high quality by providing training and technical support. The intermediary would also organise the sale of the credits produced. Indigo's business model, mentioned in the previous section, is a good example of such a structure.

However, the credits do not necessarily have to be produced by an intermediary firm. Industrial companies, who have agricultural producers in their supply chains, may also directly promote regenerative agriculture. This practice allows companies to reduce their own Scope 3 emissions produced from their own supply chains. Through this process, which is referred to as "Insetting" instead of "Offsetting", companies may, for example, encourage their contracted farmers to adopt regenerative agricultural practices.

A third method is based on the Multilateral Development Banks (MDBs) and/or a similar organisation providing guarantees for carbon credits within the scope of tackling the global ecosystem crisis. The guarantee to be provided could be structured as a purchase guarantee, a minimum price guarantee or as a guarantee of additional revenue per tonne, assuming that the MRV processes are not disrupted. We have noted the importance of establishing a structure in which carbon credit markets can function reliably in closing the climate finance gap, an area of importance for the World Bank. This would pave the way for a structure where the MDBs support the development of a regenerative agriculture-based carbon credits market.

Establishing a market in a newly developing field requires setting rules, supervision, reducing uncertainties and increasing predictability. These requirements suggest that the public sector's role as a market builder in this field will accelerate the processes and support development. In this vein, Energy Exchange Istanbul's (EXIST) cooperation with Verra, one of the world's largest carbon crediting organisations, regarding the voluntary carbon credits market and its steps to enable trading on its own platform could prove vital. [23]

[23] EPİAŞ and Verra signed the memorandum of understanding on "Carbon Credit Trading Platform Cooperation".
https://www.epias.com.tr/tum-duyurular/kurumsal/epias-ve-verra-karbon-kredisi-ticaret-platformu-isbirligi-konulu-mutabakat-belgesini-imzaladi/

Taking Care of Soil in the Earthquake Zone

As TSKB Economic Research, we had included the issue of disaster awareness and resilience in our research plan for the 2024-2026 period after the Kahramanmaraş-centred earthquakes in 2023 (Tur, 2024). The earthquake year is not a single calendar year. The recovery and reconstruction of the region and the protection of its assets, require planning and efforts that extend far beyond a calendar year. In this context, in our report published in July 2024, we mentioned that the region could be transformed into a "Green Economic Zone". As such, the earthquake zone may be the most suitable region for the first stage in the rollout of regenerative agricultural practices and the creation of carbon credits.

The prioritisation of the earthquake zone is also important due to the vulnerabilities specific to the earthquake zone, in addition to the problems facing the ecosystem which concern the entire planet and our country which we have discussed in the previous sections. A study analysing the effects of the 1999 Gölcük earthquake, which continues to occupy an important place in our collective consciousness, on SOC sheds some light on these vulnerabilities (Başaran, Akdogan Cinal, & Eroglu, 2024). The study, which examines the reconstruction process in Düzce after the earthquake, reveals that the green areas of the city are not fully able to compensate for the SOC lost due to increasing urbanisation and agricultural activity. According to the study, converting agricultural land into artificial areas with buildings and paving reduces the carbon stored in the area by 5%. Building on natural areas reduces the carbon stored by 15%, while converting natural areas into agricultural areas reduces the carbon stored by 21%. The study emphasises the need to prioritise the restoration of nature in land use decisions, while underlining that practices such as residue and fertiliser management do not only prevent the reduction of SOC, but could also help increase it.

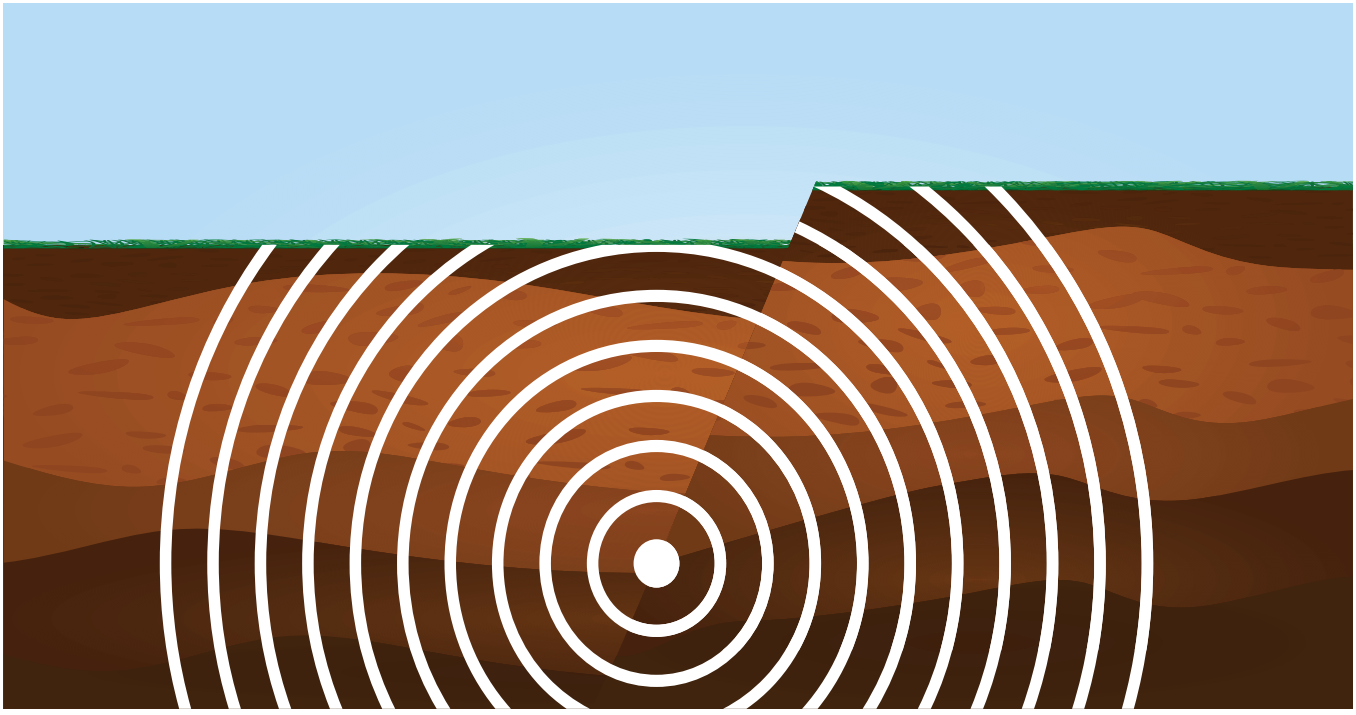
The need to restore nature is also confirmed by observations from the region. The proximity of debris removal sites to agricultural land[24], the need to protect trees in the region[25] and concerns over water pollution[26] are among the environmental problems raised. In one of the most recent assessments of the region, The Union of Municipalities of Türkiye, also draws attention to the persistence of environmental problems (Türkiye Belediyeler Birliği, 2024).

[24] Türkiye 's toxic dust. https://www.reuters.com/graphics/TÜRKİYE -QUAKE/TOXINS/znvnbmyrzvl/
[25] The problem of debris waste in the earthquake zone. https://www.bbc.com/turkce/articles/czvk4p1yv7yo
[26] How is access to safe water in the earthquake zone? https://www.bbc.com/turkce/articles/c9r04yw6qn2o

The area affected by the earthquake accounts for one third of Türkiye's total agricultural production, more than half of its grain production and almost three quarters of its fruit production. Although there are differences between provinces in the region, as a whole, the fertile soils in the region offer a positive outlook when it comes to the SOC growth potential, while presenting risks in terms of water erosion on one hand and desertification on the other. In the process of recovery and restructuring of the region, a potential uncontrolled acceleration of industrialisation at the expense of agricultural land could create undesirable results both for the region and the country in general in the long run. Therefore, a strategy which focuses on increasing the value of existing soil-based riches may help shape the recovery process of the region.

Such a strategy would also be in line with current global development and development finance topics. As a matter of fact, while the tendency towards net zero emissions gains pace, Scope 3 emissions will continue to be among the topics of discussion. We are moving towards a stage where emphasis is placed on the search for quality in carbon credits and Reduction Credits are preferred over Avoidance Credits. On the other hand, we are also seeing developed countries and Multilateral Development Banks vying to develop voluntary carbon credit markets in order to close the climate finance gap and transfer resources to developing countries.

The expansion of regenerative agriculture practices supported by the global trends, in line with the needs of Türkiye and the earthquake region, and the conversion of these practices into carbon credits through the MRV will provide multidimensional contributions to the economy, society and the environment. Positive economic impacts such as the increase in agricultural production and employment, reductions in health costs thanks to improved food quality, the downward impact on inflation and imports due to the availability of higher food quantity increase the attractiveness of regenerative agricultural practices. However, the potential positive effects are not limited to this; since they can increase access to food, there would be other positive outcomes such as food security and an increase in the skills of those who make a living from agriculture. On the environmental front, the most striking benefits will be in the areas of water retention, soil health, erosion control, biodiversity, and pollution reduction, as well as carbon capture.



Arguably the most important impact would be to help bring back some of those who left the region after the earthquake, with a policy that will be announced and implemented in a planned manner in line with the expansion of regenerative agriculture. In this sense, the policy to be implemented should not be seen only as an agricultural policy. One of the most important problems facing industrialists in the region in 2024 has been the difficulties they encounter in finding people to work. During our visit to the region in April, we noted that the provinces which felt the destruction most intensely were struggling to become "cities with life in them", referring not to economic activity but other elements that make a city a city. In this sense, a policy that can provide reverse migration to the earthquake zone will serve society, the economy and industry as well as the region as a whole. It will also contribute to the strengthening of social capital, which we had highlighted as among the priorities for the post-disaster recovery. (Ünüvar, 2023).

In this study, we propose regenerative agriculture to provide that dynamic, which can be transformed into an opportunity as it is compatible with both the soil richness of the region and the current topics of global development finance.

Focus 2:
TSKB Economic Research's Body of Work on Disasters

Due to disasters' wide range of effects, disaster resilience is at the center of many other development themes discussed in our body of work and is incorporated in the 2024-2026 research program. After the 2023 earthquakes, it is clear that the topic should be on the agenda of all economic actors. As the need to recognize, assess and understand the risks from natural hazard increases, TSKB Economic Research commits to the following for the 2024-2026 period:

- to watch the course of recovery in the earthquake region and publish reports annually,

- to consider disaster risk in macroeconomic evaluations and projections,

- to re-evaluate our development themes with regard to disaster risk,

- to contribute to the constructive dialog on topic, engage stakeholders and increase awareness.

Building on the understanding that a disaster year is not confined to a single year, with the commitments we have made we aim to:

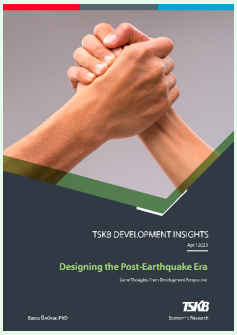
-keep the multidimensional planning of the reconstruction of the provinces affected by the earthquakes in 2023 within a development framework on the agenda of economic actors,

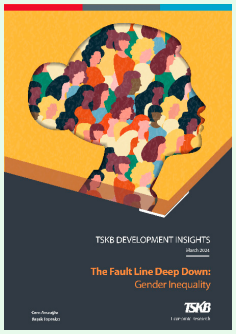
- direct the international development financing sources, which are expected to accelerate for 3 to 5 years following disasters, towards areas that will produce concrete results in line with needs and based on the right justifications,

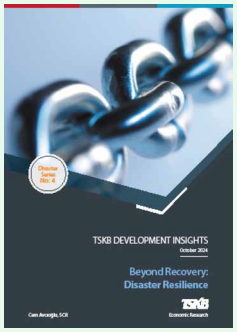
- stress the fact that earthquakes are not the only disasters and that Turkey's resilience should be enhanced against both geological and non-geological hazards,

- associate increasing disaster resilience not only with improving physical conditions but also with restoring the ecosystem and strengthening social integration,
contribute to strengthening a constructive discussion environment regarding the disaster management process.

In line with our commitment, we launched our disaster series with the "Designing the Post-Earthquake Era". With the four reports we've published so far, we offer a multi-faceted perspective to the restoration of the provinces affected by the earthquakes by focusing on a range of areas from strengthening social capital to disaster preparedness. With our fifth report in the series, "From Carbon to Credit" we are expanding the scope of our focus to include the soil-based richness of the region. We discuss how these richness can be preserved and further, protected and how this may aid the restoration process.







Epilogue

The health of our soils, which are critical for the continuity of life, is being damaged by current agricultural practices. Regenerative agricultural practices, which aim to halt and reverse this destruction, promise significant economic, environmental and social benefits. These benefits, which range from supporting food security to improving soil health, will serve as an important stepping stone towards achieving the 2030 targets by providing direct support to the following five different Sustainable Development Goals (SDGs), especially SDGs 15 and 13. In order to take the necessary steps in this direction, it is vital that farmers do not suffer losses in the short term. One of the ways to achieve this is through carbon credit markets.

In the wake of the recent volatility in carbon credit markets, the search for quality has gained pace. Agriculture-based carbon credits may prove a vital part of this process, with the establishment of this structure being a part of the public sector's active industrial policy implementation. Alternatively, such a system could be implemented with the support of the MDBs or by companies with agricultural activities in their value chain who can adopt regenerative agriculture as an insetting method.

As TSKB Economic Research, we call for the prioritisation of the earthquake region to be prioritized in the implementation of these practices in Türkiye, so social capital can be strengthened in the region while also contributing to the region's need for reconstruction.

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