Opportunities and Obstacles of Regenerative Agriculture

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Abstract

The importance of agriculture as a food producer is unquestionable in every society. In the global context of population growth and climate change, this role takes on even greater importance. It manifests itself in the increase of the social order for affordable and high-quality food. Currently, not only the conventional agriculture but also their alternatives, regenerative agriculture, contribute to ensuring the required amount and assortment of food in society. What are the possibilities and benefits of regenerative agriculture and what difficulties must be faced by those who choose this path in the conditions of Slovakia – this forms the essence of the concept of the article in question? The aim of the paper is to highlight regenerative agriculture as a challenge for farmers to improve soil health in the current state, where the main problems are lack of rainfall and high input prices. The paper analyzes, synthesizes, compares studies on the given issue.

Regenerative agriculture is a term denoting an approach to farming that reduces the use of tillage and improves soil and water quality. Both thanks to the cultivation of diverse types of plants and crops and thanks to the retention of organic matter in the land.

While studies have shown that there is a difference in crop yields between industrial farming and more traditional methods, as well as many other emerging technologies, production efficiency as the industry grows often leads to both lower costs and higher yields. The study by the US National Center for Biotechnology Information (from 2018) found that regenerative farms are 78% more profitable than conventional ones, in part due to lower input costs.

Keywords: regenerative agriculture, studies, benefits, conventional agriculture

JEL Classification: Q10, Q15

1. Introduction

Regenerative agriculture is an alternative means of producing food that, its advocates claim, may have lower—or even net positive—environmental and/or social impacts. Regenerative agriculture has recently received significant attention from producers, retailers, researchers, and consumers, as well as politicians and the mainstream media. Despite widespread interest in regenerative agriculture, no legal or regulatory definition of the term “regenerative agriculture” exists nor has a widely accepted definition emerged in common usage (Newton P, Civita N, Frankel-Goldwater L, Bartel K and Johns C, 2020).

The adjective ‘regenerative’ has been associated with the nouns ‘agriculture’ and ‘farming’ since the late 1970s but the terms Regenerative Agriculture and Regenerative Farming came into wider
circulation in the early 1980s when they were picked up by the US-based Rodale Institute. Through its research and publications (including the magazine Organic Gardening and Farming), the Rodale Institute has, over decades, been at the forefront of the organic farming movement. (Giller, K. E., Hijbeek, R., Andersson, J. A., & Sumbreg, J., 2021)

Robert Rodale (1983) defined Regenerative Agriculture as ‘one that, at increasing levels of productivity, increases our land and soil biological production base. It has a high level of built-in economic and biological stability. It has minimal to no impact on the environment beyond the farm or field boundaries. It produces foodstuffs free from biocides. It provides for the productive contribution of increasingly large numbers of people during a transition to minimal reliance on non-renewable resources’.

2. Data and Methods

For research we reviewed publications as journal articles, articles in magazines, web portal, web blogs , where regenerative agriculture was solved Our searches were designed to generate representative insights into the diversity of use of the term “regenerative agriculture.” But the searches were not designed to be completely systematic nor completely exhaustive, nor did they need to be for the purposes of responding to our research question.

The paper analyzes, synthesizes, compares studies on the given issue of regenerative agriculture.

3. Results and Discussion

Climatic changes

Climate change is becoming one of the biggest environmental policy challenges of the 21st century. The World Economic Forum’s report on global risks (WEFGR, 2017) included among the 5 biggest global risks, in addition to weapons of mass destruction, four risks somehow connected to climate change, namely (I) extreme weather, (II) water crisis, (III) natural disasters and (IV) failure of mitigation (elimination) and adaptation (adjustment) measures against climate change.

Agriculture also contributes to and is significantly affected by climate change.

In Europe and around the world, the consequences of climate change are becoming more and more noticeable. The average global temperature continues to rise. Some natural processes and precipitation patterns are changing, glaciers are melting, sea levels are rising and the water temperature in the oceans is increasing.

Although the manifestations of climate change are different around the world and in regions, its adverse consequences on socio-economic and natural systems are increasingly significant and require an active solution. Global warming is clearly happening, faster than some scenarios in the past have predicted. The updated linear trend (1906–2005) shows a temperature increase of 0.74 °C (in the last 50 years it shows an average warming trend of 0.13 °C per 10 years). By 2100, the Earth may warm on average by 1.5 to 4.5 °C compared to pre-industrial levels. The continued increase in air temperature will result in a reduction in the ability of the earth's surface (including seas and oceans) to absorb CO2. It is very likely that periods of extremely high temperatures and torrential rainfall will become more frequent. A temperature increase of 1.5 to 2.5°C will cause 20 to 30% of plant and animal species to be affected and hundreds of millions of people on the planet will suffer from water shortages. According to the most pessimistic scenarios, the air temperature on Earth will increase by about 7 °C and the ocean level will rise by approximately 0.6 m by the end of this century. Atmospheric
concentrations of carbon dioxide, methane and nitrous oxide have risen to levels that exceed those of the past 800,000 years, mainly as a result of human activity, such as the production of emissions from burning fossil fuels or from land-use change and deforestation.

The share of the production of the crucial greenhouse gas – CO2, according to sources, in 2014 was as follows: 37% – electricity production, 31% – transport, 15% – industry, 10% – housing and services, 7% – others. We consider agriculture to be generally indifferent – within the balance of production and sequestration of CO2, this balance is balanced – how much carbon dioxide is released into the atmosphere during the year, during agricultural activity, how much is also bound from the atmosphere into the new organic matter of agricultural crops through photosynthesis and cultures.

CO2 production by country in billion t and the resulting percentage of global production (35,890 t) is as follows: 1. China – 9,680 t (27.0%), 2. USA – 5,561 t (15.5%), 3. EU – 3,420 t (9.5%), 4. India – 2,597 t (7.2%), 5. Russia – 1,595 t (4.4%), 6. Japan – 1,232 t (3.4%), 7. Indonesia – 0.641 t (1.8%), 8. Iran - 0.616 t (1.7%), 9. Saudi Arabia - 0.602 t (1.7%) and 10. South Korea - 0.599 t (1.6%).

Together, these ten biggest polluters of the atmosphere with CO2 produce 73.8% of it, which is basically three quarters of its global annual production.

In Central Europe, since the end of the 19th century, the average air temperature has increased by approximately 2 °C in both the warm and cold half of the year. The increase in temperature in the other 37 years (since 1980) was significantly the highest in the entire era of meteorological measurements in Central Europe (since 1775) and is probably the highest in the other 2,000 years for the same period of time. Precipitation totals have not had a significant trend in Central Europe since the end of the 19th century, but their variability has increased. (Smatana, J., Macák, M.,2022)

The goal of regenerative farming systems (Rodale, 1983) is to increase soil quality and biodiversity in farmland while producing nourishing farm products profitably. Unifying principles consistent across regenerative farming systems include (1) abandoning tillage (or actively rebuilding soil communities following a tillage event), (2) eliminating spatio-temporal events of bare soil, (3) fostering plant diversity on the farm, and (4) integrating livestock and cropping operations on the land. Further characterization of a regenerative system is problematic because of the myriad combinations of farming practices that comprise a system targeting the regenerative goal. Other comparisons of conventional agriculture with alternative agriculture schemes do not compare in situ best management practices developed by farmers, and frequently ignore a key driver to decision making on farming operations: the examined systems’ relative net profit to the farmer. (LaCanne CE, Lundgren JG., 2018)

From the research activities of many authors we can see that the main principles of regenerative agriculture are:

- Minimising soil disturbance
- Minimising the use of chemical inputs
- Maximising biodiversity, both animals and plants
- Keeping the soil covered with crops as long as possible
- Adapting to the local environment

These are put into practice under a general, guiding principle of integrating all the farm’s operations as far as possible. In today’s conventional farming approach, crops and livestock production are
typically kept separate. Regenerative agriculture combines them in circular ecosystems; essentially, the animals feed the plants, and the plants feed the animals. The regulated grazing of sheep or cows, for example, encourages plant growth, and distributes natural nutrients back over the land in the form of dung. Poultry also fertilises land, as well as eating unwelcome bugs and weeds.

Growing crops can also remove and add nutrients, and regenerative farmers use growing practices that improve the health of their land. The more common regenerative farming methods include:

- No-till systems, which heavily reduce the digging and ploughing that can lead to loosened topsoil being blown away by wind or carried away by water
- Cover crops, which are grown in the soil when the main commercial crop has been harvested, and can be grazed by livestock or harvested themselves
- Increasing biodiversity, which increases the variety of nutrients going into the soil through roots and natural decomposition and, if well-managed, attracts insects which are the natural predators of pests
- Rotating crops, so that what is being taken out and put into soil naturally by plants is balanced
- Integrating livestock, so as to combine animals and plants in a single ecosystem
- Minimising chemical inputs, to minimise negative impact on biodiversity and pollution of waterways due to runoff. (EIT Food, 2022)

The conventional agriculture vs the regenerative agriculture

The basis of conventional agriculture is tilling the soil, usually in the following sequence: tillage – plowing – pre-sowing soil preparation – sowing – rolling. Plowing with plowshares and disc plows has adverse consequences for soil biota. During plowing, the upper soil horizon is turned by approx. 25 cm. Organisms living in the surface layer of the soil get into unsuitable conditions in depth, and vice versa – organisms from the "inside" of the soil get to the surface. Some of these organisms are able to relocate, but a large part dies due to unsuitable conditions. This is mainly due to the illumination of the soil and the rapid drying of the layer that was 25 cm deep before plowing. Soil aggregates are broken during pre-sowing preparation and become pseudo-aggregates that are not resistant to water erosion because they are not stabilized. All corridors, channels for edaphon and dead roots, important for the natural water regime of the soil, will be disturbed. The consequence is that the soil is loose after cultivation, but prone to re-consolidation during rainfall. After a heavy rainfall, air cannot enter the soil until the network of channels is formed anew. Infiltration of larger amounts of precipitation is very limited.

Conventionally cultivated soils have low biological activity, sometimes only at the level of 10% biological activity of regeneratively cultivated soils. As a result of conventional farming, the soil has poor resistance - resistance to external influences, and fertility must be maintained by supplying fertilizers in conventional agriculture. A dysfunctional soil ecosystem results in an increased incidence of pests and diseases, which are fought with chemical protective substances. These agrochemicals further reduce the functionality of the ecosystem, thus closing the circle. Simple crop rotation and the cultivation of monocultures on large areas also contribute to this. After harvesting the main market crop, the fields are left bare and not covered by any vegetation, where intensive mineralization of organic matter takes place in autumn. Carbon is oxidized into the atmosphere and contributes to climate change, nitrogen is leached into surface and groundwater. Bare soil is also extremely susceptible to wind and especially water erosion.

Regenerative agriculture can produce the same yields per hectare as conventional agriculture. It protects the soil and our homes from water erosion and flooding. It captures nutrients where they
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should be, i.e. in the soil and not in the water. It also contributes to mitigating climate change – by growing plants, atmospheric carbon dioxide is captured and transferred to the soil, where it is effectively bound. This effective technology thus helps capture greenhouse gases that are already in the atmosphere. (Čaja, R. 2021)

Although the concept of regenerative agriculture was developed in the 1970s, there is still no consensus definition and although regenerative agriculture is gaining increasing international interest, a critical scientific evaluation of objectives and assumptions has yet to be made. Furthermore, there is a multitude of other concepts that also relate to sustainable agriculture: for example agroecology, conservation farming, organic farming, ecological intensification and carbon farming, among others. Regenerative agriculture, as defined in Oberc and Arroyo Schnell (2020), addresses similar objectives as many of the other above-mentioned concepts and approaches: maintaining agricultural productivity, increasing biodiversity and enhancing ecosystem services including carbon capture and storage. (Oberč, B.P., & Schnell, A.A., 2020). In contrast to other related concepts, regenerative agriculture is not viewed as defined a priori by a given set of rules and practices; instead, the goals that should be achieved are set and then practices and new technologies are adopted over time which contribute to achieve these goals. Regenerative agriculture explicitly stresses the opportunities of restoration, especially for soils in the agricultural landscape and the interplay in the production chain of various crops and ruminant and non-ruminant farm animals. These are principles also found in agroecology and organic agriculture. The concept is nonetheless viewed as broader and less prescriptive than other related concepts. Therefore, in contrast to some of the other approaches, regenerative agriculture does not exclude the use of, for example, modern plant and animal breeding technology, tilling, use of inorganic fertilisers or pesticides, but instead aims for a limited and more targeted use. A characteristic feature that regenerative agriculture shares with other concepts is that it aims to go beyond just reducing negative environmental effects of agriculture to actually producing positive environmental externalities. (EASAC, 2022)

Main advantages of regenerative agriculture

The main advantages of regenerative agriculture:

Ecologically regenerative: it is a type of agriculture that is able to restore the potential of ecosystem services. These are services offered by nature and which are intangible. This means that these services are, for example, the absorption of carbon dioxide from the atmosphere during the process of photosynthesis. It is not a service that we can quantify or value economically, but we are offered an important service.

Economically beneficial: By improving soil conditions, variable production costs can be drastically reduced. It also helps increase the yields they achieve by producing more crops.

Socially cohesive: Because it is a way to increase performance and productivity, it can create employment and wealth at the local level. It is a good way to unite people around a new vision. (JardineríaOn, 2022)

Regenerative agriculture in the World

The Rodale Institute has been running side-by-side field studies for the last 30 years, comparing organic and conventional agriculture. Results show that after a 1 to 2 year transition period, when yields tend to decline, there is no difference between conventional and regenerative farming in terms of yields. In stressful conditions, particularly during droughts, the regenerative fields perform better because they
are more resilient – the soil can absorb more water because it contains more biomass. And certainly farmers we work with say the yields are the same, while their input costs go down.

Crucially, even where yields are lower, the price premium on regenerative and organic food can make the crops more profitable than their conventionally-grown counterparts. In 2018, US researchers showed that on farms in the Northern Plains of the USA, regenerative fields had 29% lower grain production but 78% higher profits over conventional corn production systems. The picture can be complex, and there are differences when it comes to input costs: regenerative and organic farming tend to have higher labour inputs, while conventional use more pesticide and fertiliser.

The global regenerative agriculture market was valued at USD 7.74 billion in 2021 and is expected to grow at a CAGR of 14.4% during the forecast period. Rising awareness and adoption of regenerative agriculture, along with development due to increased concern and understanding about agriculture’s depletion of water, land, and air condition, is expected to propel regenerative agriculture market growth during the forecast period.

Regenerative agriculture in Slovakia

According to the principles of regenerative agriculture, an estimated 6,000 ha of land is farmed in Slovakia, which is less than 0.4% of Slovakia’s arable land (1,408,428 ha). Regenerative agriculture practices are managed by two larger agricultural entities and several smaller self-employed farmers. For comparison – the area of land registered in organic production as of September 2021 is 10.46%. Compared to 2019, this is a slight increase, when a total of 859 entities were registered in the system of organic agricultural production in the Slovak Republic, managing approximately 196,209.9 ha of agricultural land, which represented 10.19% of the total area of agricultural land. In addition, we have 851,718 ha of permanent grassland and 118,955 ha of orchards, vineyards and gardens, where agroforestry systems can be considered on a small part.
There are many agronomists who are interested in the topic, but they are hindered by the economic separation of companies. Business economists are not familiar with the topic and object to the higher prices of sowing with a no-till seed drill. Savings in other activities and thus lower costs are often not taken into account. The average consumption of diesel in conventional agriculture is around 110-120 l/ha/year. Diesel consumption in regenerative agriculture is around 45 l/ha/year. Restraint in the agricultural sector is largely related to the conservative approach of the population of Slovakia to adopting new procedures in general. Willingness to introduce changes and new technologies is low. The fear of possible economic instability during the transition to regenerative agriculture also plays a role. The transition to no-till farming is generally associated with a temporary reduction in yields by 10-20%, which is, however, compensated by a more significant reduction in costs (30-40%). So the farmer does not make a loss in the first year of the transition. After an average of five years (3 to 8 years), the fertility returns to the level of conventional farming. At lower costs, this means higher profitability for the farmer. This time depends on the type of soil (sandy, loamy, clayey) and the degree of its degradation before the start of the transition.

4. Conclusion

In the 21st century conventional agriculture incurs other indirect costs that cannot be ignored. The long-term threat of climate change to the natural environment is well established, and agriculture bears much of the responsibility for this. In its latest report on climate change, the IPCC states that 23% of the total global greenhouse gas (GHG) emissions are directly related to “agriculture, forestry and other types of land use”. Conversely, regenerative agriculture seeks to increase the organic matter in soil, which makes it better able to sequester carbon from the atmosphere, meaning it has the potential to reduce climate change instead of contributing to it.

Some regenerative farmers argue that their grazing techniques can play a significant role in reducing the carbon intensity of agriculture, and while some of these claims have been credibly disputed, some scientists endorse the findings.

Regenerative farming has other demonstrable benefits besides improving soil health and helping to fight climate change. Improving the soil not only increases fertility in a sustainable way, but also tends to improve water infiltration. Better infiltration means less runoff, and also less erosion and pollution from soil being carried away in the runoff water. In some areas, water springs that dried up several years ago have begun to flow again due to new regenerative farming approaches.

In integrating different elements on the farm, the regenerative farmer seeks to revive the classic mixed-farm model, which is an important consideration in food industry. By producing a greater diversity of foodstuffs on one site, a farm can reduce external inputs and outputs, and thus reduce the risk of contamination.

However, to practice regenerative agriculture effectively, many farmers will need to acquire new knowledge and skills, particularly in respect of soil management. And managing farmers’ expectations of results might be difficult, as critics have accused exponents of over-claiming on yield and benefits. By not tilling the soil, farmers can save between 30 and 40 percent of time, and can decrease the amount of soil erosion in certain terrains, but the disadvantages of regenerative agriculture are, in many cases, that more unwelcome plants grow on the land, and some farmers compensate for this by increasing their use of herbicide.
Therefore, the main disadvantages of regenerative agriculture are:

- Farmers will need to acquire new knowledge and skills
- Less tilling may lead to more unwelcome plants
- Some farmers compensate by increasing their use of herbicides
- Potentially lower yields, dependent on crop and local conditions
- The transition away from conventional methods will take time

Regenerative farming clearly has some way to go yet before it can offer an alternative to current conventional, large-scale agriculture. However, it’s equally clear that it is a source of important ideas and influence. For farmers, a regenerative approach can offer new profitable and nature-friendly economic models. For policymakers, it offers alternative ways of thinking about sustainability. And for changemakers looking to reduce the negative impacts of farming, it represents small actions and changes that are closely linked to a large-scale vision. (EIT Food, 2022)

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References


