Prospects for the Development of Organic Agriculture: Regenerative Animal Husbandry and Agriculture

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Abstract: For farm animals to be productive (milk, eggs, meat, etc.), it is important that they receive suitable food in sufficient quantities. If farm feed production is limited (as is usually the case), it may be economically feasible to keep fewer animals but provide them with enough food. The appropriate amount and composition of feed will, of course, depend on the type of animal as well as its primary use (eg chicken for meat or eggs, cattle for milk, meat or draft power, etc.). For example, in milk production, milk producing cows should be given fresh grass and possibly other feeds with adequate protein content. On the same diet, draft animals were rapidly depleted. A balanced diet will allow the animal to remain healthy and productive. Whether a farm animal is receiving the proper amount and type of food can usually be seen by the sheen of its coat or feathers. For ruminants, most of the feed should be roughage (grass, leaves, etc.). If concentrates or additives are used (eg agricultural by-products and waste), they must not contain growth promoters or other synthetic substances. Instead of buying expensive concentrates, there are plenty of protein-rich legumes that can be grown on the farm as cover crops, hedges, or trees. If the mineral content of the available feed is insufficient to meet the needs of the animal, mineral salt bricks or similar feed additives may be used, as long as they do not contain synthetic additives.

1 INTRODUCTION

Claims that the global food system is “in crisis” or “not working” are becoming more common (Aksyutik, 2020; Surowiecki, 2021). Such statements point to a wide range of illnesses, from hunger, poverty and obesity; through industrial agriculture, over-reliance on chemical fertilizers and pesticides, substandard (if not unsafe) food, environmental degradation, biodiversity loss, exploitative labor relations and animal welfare; to corporate dominance and lack of sustainability. It is in this context, when every aspect of agriculture and food production, distribution and consumption is questioned, that the current interest in "Regenerative Agriculture" and "Regenerative Agriculture"3 has taken root. While the use of the adjective "regenerative" is on the rise among activists, civil society groups and corporations as they call for the renewal, transformation and revitalization of the global food system, in this article we examine the calls for regenerative agriculture from an agronomic perspective. By this we mean a perspective based on the use of plant, soil, ecological and systems sciences to support the production of food, feed and fiber in a sustainable manner. In particular, we address two questions (Souter, 2019):

1) What is the analysis of agronomic issues that motivates the movement for regenerative agriculture, and what is the evidence base for this analysis?
2) What agronomic solutions are being proposed and how well are they supported by the facts? Our frankly agronomic approach to regenerative agriculture means that some important aspects of describing a "food system in crisis" are beyond the scope of this article,

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such as nutritional inequalities and labor relations. However, apart from agronomic science, our analysis is based on historical and political economy perspectives. This suggests that the food system is best seen as an integral part of a much wider network of economic, social and political relationships. It follows that many of the deficiencies attributed to the food system, including hunger, food poverty, poor labor relations, corporate dominance, will not be successfully addressed by action within the food system, but only through political and economic change at a higher level. The article continues as follows. The following section explores the origins of regenerative agriculture and the different ways in which it can be defined. It then explores two crises that are central to the rationale for regenerative agriculture – soils and biodiversity. The next section looks at the practices most commonly associated with regenerative agriculture and assesses their potential to address the aforementioned crises. The final section of the discussion presents a number of questions that may be useful to research agronomists involved in regenerative agriculture (Braverman, 2019).

In many areas of the tropics, favorable periods with abundant food alternate with less favorable periods when the animals have little to feed. However, keeping animals means providing food throughout the year. Forage can be produced on the farm in the form of pastures or in the form of grass or woody crops used for cutting.

Although grazing requires less labor than barn feeding, more land is required and appropriate measures must be taken to keep animals away from other crops (Korchagina, 2019). Grazing can reduce productivity (dairy, beef, etc.) but is usually a better option in terms of animal health and welfare. However, barn storage has the advantage that manure can be easily collected, stored or composted and applied to crops. The choice of pasture or surface feeding will mainly depend on agro-climatic conditions, cropping system and land availability. A combination of hanging feeding and grazing in a fenced area can be the perfect combination of high productivity and animal welfare. However, in large pastures in semi-arid areas, grazing may be the only viable option.

2 RESEARCH METHODS

The adjective “regenerative” has been associated with the nouns “agriculture” and “farming” since the late 1970s (Gakaev, 2020), but the terms “regenerative agriculture” and “regenerative agriculture” became more common in the early 1980s when they were picked up American Institute of Rodale. Through its research and publications (including the journal Organic Horticulture and Agriculture), the Rodale Institute has been at the forefront of the organic farming movement for decades. Robert Rodale defined regenerative agriculture as “one that, while increasing levels of productivity, increases our biological production base of land and soil. It has a high level of inherent economic and biological stability. The environmental impact outside the farm or field is minimal or non-existent. It produces biocide-free food products. It provides for the productive contribution of an increasing number of people in the transition to minimal dependence on non-renewable resources.” Richard Harwood, an agronomist who made his name in the international farming systems research movement, was the director of the Rodale Research Center when he published the "international review" of regenerative agriculture. The review goes to great lengths to contextualize regenerative agriculture in relation to the historical evolution of the various schools of organic and biodynamic farming, but it also highlights Rodale's suggestion that regenerative agriculture goes beyond organic as it involves changes in "macrostructure" and "social value". ', and seeks to increase rather than decrease productive resources. Harwood summarizes the "Philosophy of Regenerative Agriculture" in 10 points. He further states that this philosophy emphasizes (Vladimirov, 2019):

1) the relationship of all parts of the farming system, including the farmer and his family; 2) the importance of countless biological balances in the system; and 3) the need to maximize the desired biological relationships in the system and minimize the use of materials and methods that violate these relationships” (Vladimirov, 2019; Molchanova, 2019).

The points summarizing the philosophy of regenerative agriculture are presented in the following form (Molchanova, 2019):

1. Agriculture must produce highly nutritious, biocide-free food with high yields.
2. Agriculture should increase, not decrease, soil productivity by increasing the depth, fertility, and physical characteristics of the topsoil.

3. Nutrient flow systems that fully integrate soil flora and fauna into the structure, are more efficient and less damaging to the environment, and provide better crop nutrition. Such systems introduce a new upward flow of nutrients into the soil profile, reducing or eliminating adverse environmental impacts. Such a process is, by definition, a process of soil formation.
4. Crop production should be based on biological interactions to ensure stability, eliminating the need for synthetic biocides.
5. Substances that disrupt the biological structure of the farming system (eg modern synthetic fertilizers) should not be used.
6. Regenerative agriculture requires in its biological structure a close relationship between the manager/participants of the system and the system itself.
7. Integrated systems should be used that are largely self-sufficient in nitrogen through biological nitrogen fixation.
8. Animals in agriculture should be fed and managed in such a way as to avoid the use of hormones and the prophylactic use of antibiotics, which are then present in human food.
9. Agricultural production should contribute to increasing the level of employment.
10. Regenerative agriculture requires planning at the national level, but a high degree of self-sufficiency at the local and regional levels to close nutrient flow loops.

In most small farms, forage growing will compete for space with crop growing. Whether growing feed (and hence livestock) is more economical than crop production needs to be assessed on a case-by-case basis. However, there are several options for integrating forage crops into farms without damaging the land. Below are some examples (Molchanova, 2019):

- grass or legume cover crops on plantation trees;
- hedges of suitable shrubs;
- shade or support trees;
- grass on embankments against soil erosion;
- grass fallow or green manure in crop rotation; and
- crops with by-products such as paddy straw leaves or peas.

Pasture management is critical to good herd management. It is also important to practice appropriate management throughout the year. There are many different types of grasses, and in each climatic region there are grasses specially adapted to the conditions (Vladimirov, 2019).

In some cases, it may be worth considering tilling the pasture and planting grass that is more suited to the needs of the animal. Overgrazing is perhaps the most serious threat to pastures. After the destruction of the protective grass cover, the topsoil is subject to erosion. Degraded pastures or lands with little vegetation cover are difficult to reclaim. Therefore, it is important that the use and intensity of grazing on a particular piece of land correspond to its productivity. The pasture should be allowed enough time to recover from heavy grazing (Reynard, 2020).

Pathogenic microbes and parasites are present almost everywhere. Just like humans, animals have immune systems that are usually able to deal with these microbes. As with humans, the effectiveness of the immune system will be compromised if the animals are not properly nourished, unable to practice their natural behaviors, or are under social stress. Health is a balance between the pressure of disease (i.e., the presence of germs and parasites) and the resistance (i.e., the immune system and self-healing powers) of the animal. The farmer can influence both sides of this balance by reducing germs, maintaining good hygiene, and increasing the ability of animals to cope with germs. Organic animal husbandry aims to improve the living conditions of animals and strengthen their immune systems. Of course: if the animal is sick, it must be treated. However, the farmer should also consider why the animal's immune system was unable to fight off a disease or parasite attack. Also, the farmer should think about how to improve animal welfare and hygiene in order to strengthen it (Mauritzen, 2016).

As with crop health, organic farming focuses on preventive measures to keep animals healthy, rather than curative methods. This starts with the preservation of robust, rather than high performing, but highly susceptible breeds. Further, the conditions for keeping animals should be optimal, providing sufficient space, light and air, dry and clean bedding, frequent walks, i.e. grazing and proper hygiene. The quality and quantity of feed are crucial for animal health (Gakaev, 2020). Instead of feeding on commercial concentrates that make animals grow faster and produce more, a natural diet that meets the needs of the animal should be achieved. With all these preventive measures, animals rarely get sick. Thus, veterinary treatment should play only a minor role in organic farming (Vladimirov, 2019). If treatment is needed, alternative medicine based on herbs and folk remedies should be used. Only when these therapies are ineffective or insufficient should synthetic drugs be used (eg antibiotics, parasiticides, anesthetics, etc.); in these cases, the treated animals must be separated from the untreated organic stock and excluded for a certain period of time, eg. at least 3 weeks from the date of organic certification. The main reason for veterinary treatment in organic animal husbandry is to study the causes (or contributing factors) of diseases in order to enhance the animal's natural defense mechanisms (and prevent their occurrence in the future). Unlike crop production, synthetics are allowed to treat sick animals if alternative treatments are not enough. Here, reducing the suffering of the animal is prioritized over the elimination of chemicals.

3 RESULTS AND DISCUSSIONS

Soil health is a particular focus of narratives related to regenerative agriculture. Indeed, the idea that soil and soil life in particular is under threat is at the heart of most, if not all, calls for regenerative agriculture. However, the term "soil health" is inherently problematic. Just like soil quality, soil health is a container concept that needs to be disaggregated to make sense. While this can be seen as something positive to strive for, the basic soil functions need meaningful indicators that can be measured and tracked over a long period of time. Moreover, cultural practices that benefit one aspect of soil health (eg, soil life) often have a negative impact on other functions; there is usually not one direction in soil health, but several trade-offs (Reynard, 2020). Many websites and testimonials about regenerative agriculture emphasize the importance of soil biodiversity and in particular the macro- and micro-organisms that are responsible for the biological cycling of nutrients. Reports of reduced soil biodiversity with intensive farming and the simplification of soil food webs have raised widespread concerns about soil health. For example, a recent advisory body report to the Dutch government was ambiguously titled, as the word "bodem" means both bottom and soil. The report argues that the quality of the soil has declined to a critical point - at least in part due to the loss of soil biodiversity. While research clearly identifies differences in soil food webs between cultivated fields, pastures, and (semi-)natural vegetation, the relationship with soil function is largely established through correlation—there is little evidence of any direct causal relationship between soil biodiversity and soil biodiversity. any loss of function. . The mantra "feed the soil, not the crop" has long been central to organic agriculture, while the importance of creating soil organic matter has been emphasized by proponents of organic or biodynamic agriculture, as well as in more traditional agricultural discourses in the US and elsewhere (Meckling, 2020). Soil takes centuries to form, and significant loss of soil through erosion is unsustainable. The dust bowl of the 1930s in the United States became a seminal experience for both scientific and public acceptance of the soil. It is commonly stated that a quarter or more of the earth's soils are degraded, although exact numbers are disputed. Commonly cited estimates of soil loss by erosion are made using runoff plots, which tend to overestimate the rate of loss because they do not account for the deposition and transport of soil across the landscape. However, assume that the rate of soil loss exceeds the rate of soil formation by an order of magnitude, assuming that a third of the soils for which data were available have a lifespan of less than 200 years. A related long-term trend drawing attention to soils is the decline in the global soil carbon pool and its contribution to global warming. Recent modeling estimates the historical loss of soil carbon due to human land use at about 116 pg of carbon, comparable to about one-fifth of industry's total greenhouse gas emissions. Most of these losses are due to changes in land use. Conversion of natural vegetation, especially forests, almost always results in a decrease in SOM content due to non-permanent vegetation, removal of biomass and, consequently, a decrease in organic matter input. However, the loss of soil carbon from land-use conversion is different from the losses or benefits that can be achieved by changing management practices on existing agricultural land (Hibbard, 2019).

Supporters of regenerative agriculture attribute the biodiversity crisis to the widespread use of monocultures along with heavy dependence on external resources and the absence of "biological cyclicity". Undoubtedly, large areas of genetically homogeneous crops can be subject to the rapid spread of pests and diseases and do little to improve the quality of rural landscapes. If we consider biodiversity in a broader sense, there is little doubt that the Earth has entered its sixth mass extinction. The increase in population, the clearing of primordial habitat and the expansion of agriculture over the last century are clearly the root causes. How best to halt this loss of biodiversity is less clear. Optimistic projections suggest that the world's population will peak at 9.8 billion in 2060, while the United Nations Population Program predicts a population of 11.4 billion by the end of the century. In any case, population growth will undoubtedly require the production of additional nutritious foods. Moderate consumption patterns and dietary change can reduce this demand, as can food loss and waste, but the most conservative estimate is that overall global food production should increase by at least 25% (Molchanova, 2019; Reynard, 2020; Monasterolo, 2018).

3.1 Figures

Figure 1: A variety of forage grasses, both for fattening and for grazing.

Figure 2: Leaves and twigs of legume trees, rich in protein and widely available during the dry season.

4 CONCLUSIONS

The article presented lists of practices associated with various regenerative agriculture options, which we order based on agronomic principles. It should be noted that chemical fertilizers or synthetic pesticides cannot be used to define regenerative organic agriculture, and soilless cultivation methods are also prohibited. Many practices associated with regenerative agriculture such as crop rotations, cover crops, livestock integration are generally considered (or in some cases have been considered) "good agricultural practice" and remain an integral part of traditional farming. Some of them are more problematic: conservation agriculture, for example, can be carried out within an organic structure or on the basis of GMOs, with intensive use of herbicides and fertilizers (Meckling, 2020; Hibbard, 2019). Others, such as permaculture, have a rather limited use for the production of many agricultural commodities. Still others, such as holistic grazing, are highly controversial in terms of claims of broad applicability and environmental benefits in terms of soil carbon storage and reduction of greenhouse gas emissions. The potential of perennial cereals has generated considerable interest in relation to regenerative agriculture. Deep-rooted perennial grasses such as wheatgrass (Thinopyrum intermedium), cereals (such as sorghum), or legumes (such as pigeonpea) have the advantage of providing multiple products such as forage as well as grain, and provide continuous soil cover that can stop soil erosion and reduce nitrate leaching. On the other hand, perennial cereals tend to yield less than annual varieties and share limitations with monocultures in terms of the spread of pests and diseases. They may also have difficulty controlling weeds. Snapp et al. conduct a detailed analysis of the potential of perennial crops.

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