0110 - Regenerative agriculture in China

Exhibitor

The Nature Conservancy in China

https://www.nature.org/en-us/

Team

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Location

Beijing | China

Summary

Hallo

Presentation

1 Regenerative Agriculture practices

1.1 no-till

No-tillage seeding is an operation technique to reduce water erosion, wind erosion and improve soil fertility and drought resistance by returning the straw to the field and seeding without tillage. It has multiple advantages such as retaining runoff, increasing soil infiltration, improving soil structure and optimizing cultivated land environment.

When combined with other regenerative measures, no-till can enhance soil filtration and water retention and stabilize carbon storage . This technology was introduced in China in the 1950s, and has been widely applied afterwards. In 2017, China's "conservation" farmland reached 7.584 million hectares, with mechanized straw mulching returning, no-till and subsoiling covering 5.033 million hectares, 14.116 million hectares and 11.121 million hectares respectively. After years of efforts, the promotion of no-till in the black land of northeast China has made significant progress. In 2020, China launched the Action Plan for conservation tillage of the black land in northeast China, and began to comprehensively promote its application in suitable areas.

1.2 crop rotation

Crop rotation refers to the cultivation of different crops in a prescribed order on the same land. Crop rotation is conducive to the improvement of biological diversity, which can promote the balanced use of various elements in the soil, improve fertilizer efficiency, soil structure, and prevent diseases and insect pests. A diversified ecosystem can effectively improve the health level and ecological service function of soil. Jie Zhao et al. summarized 45 crop rotation studies in China, and found that compared with continuous monoculture, crop rotation improved the yield per unit area by 20% due to its multiple improvements in soil ecological environment, and the effect of rotation on crop yield was more obvious in southwest China (+ 38%) than in eastern China (+ 10%).In sandy and loam soils, i.e., initial soil organic carbon (7-10 g/kg) and lower total nitrogen (1.2 g/kg), crop rotation had greater yield benefits.

1.3 Cover crops

Between crops, many fields have a period of free time from planting crops. If a plant is planted during this period to provide stable soil cover, it is called a cover crop. Cover crop is a key technology in regenerative agriculture. They protect soil from wind and water erosion, reduce runoff, sediment and nutrient loss, and maintain soil fertility, thereby reducing the application of nitrogen fertilizer. A study conducted in the Northwest Pacific of United States showed that Austrian winter peas, Hairy vetch and NITRO Alfalfa can provide 80 to 100 % of the nitrogen requirements of subsequent potato crops. Cover crop is also an important measure to alleviate water pollution and improve water quality. Another study showed that rye mulch quickly absorbed 25 to 100 % of residual nitrogen in Georgia State's conventional and no-till corn fields, reducing non-point source pollution of surrounding water from excessive nitrogen fertilizer. Cover crops can effectively control weeds and accumulate soil carbon. The ideal cover crop is one that stops its growth (frosting, cutting, crushing) before flowering, so that it does not produce seeds that turn into weeds. While alive, photosynthesis is an important source of soil carbon, which can be used as biomass after death.

Cover crops have spread rapidly in the United States in recent years after farmers' planting practices found that they can quickly improve soil health, increasing corn and soybean yields by 9.6 % and 11.6 % during droughts. Cover crops differ from the crop residue retention advocated in conservation tillage, which is a live mulch crop planted during the idle period of the field. Cover crops not only increase biodiversity, but also greatly increase the amount of soil biomass. They have different functions due to their different characteristics, such as ryegrass with large root systems, two-meter tall Sudan grass that can suppress weeds, and hairy vetch that can suppress soil compaction, so the mixed seeding-cocktail mix is also the trend. Cover crop acreage in the United States reached 6.23 million hectares in 2017, up 50 % from five years earlier, and the relevant research and application of this measure in China are mostly limited to leguminous green manure. The planting of which was mainly distributed in China's rice area, north China, northwest China and southwest China, and reached its peak in the 1970s, with the highest area of about 13 million hectares. However, due to the popularization of chemical fertilizer, the planting area of green manure decreased rapidly afterwards.

1.4 Holistic grazing

Despite the rapid development of planting and breeding industry in China, the overall shortage of feed and grain supply, lack of nutrition and high price have become the restricting factors for the development of domestic animal husbandry in recent years. Holistic grazing is a model that considers animal welfare and thus improves the yield and quality of livestock products. Traditional captive breeding systems are often unhealthy mono-production systems that feed animals with low nutrient density and that increase water pollution and antibiotic use. Holistic grazing was developed by Allan Savory to mimic nature itself, allowing herds of domesticated animals (mainly cattle) to move through the fields in good time and release their wastes onto the soil . Good grazing practices promote plant growth, increase soil carbon deposition, and increase the productivity of the entire pasture, along with significant improvements in soil fertility, insect and plant biodiversity, and soil carbon sequestration. These measures have not only improved ecological health, but also the health of animals and consumers. Holistic grazing allows rapid restoration of the topsoil within a few years (usually may take 200 to 1000 years to form), and the new topsoil is rich in organisms. This has been proved by practice: in three years the soil has been successfully cultivated to be 10cm thick. In a 10-year experiment, it was found that fields rotated with composted cow dung could absorb more than two tonnes of carbon per hectare per year. In addition, when compost is used instead of synthetic nitrogen fertilizer, it encourages plants to grow more roots and trap more carbon dioxide. It also improves the production and quality of livestock products by improving animal welfare (the "Five Freedoms" for animal welfare developed by the Compassion in World Farming (CIWF)).

2 Typical case analysis

2.1 Rodale Institute's comparative study on agricultural patterns of corn and soybean

The Rodale Institute has been working with researchers around the world for more than 30 years to monitor long-term practices in regenerative agriculture, such as in the American Midwest and in the Neotropical agricultural region of Costa Rica

. Since corn and soybeans account for nearly half of the total acreage in the United States, the two crops have been identified as research priorities, with major technical measures for regenerative agriculture including no-till, crop rotation (seven crops in eight years), cover crops and organic manure. The main technical measures of conventional agriculture include continuous tillage, pesticide application and bare land during idle periods of planting. Through the adoption of regenerative agriculture, it was found that compared with conventional agriculture, soil organic matter content was significantly increased and local soil health was rapidly improved. Without affecting production, farmers in the region can not only reduce input, but also gain more profits, and effectively help reduce greenhouse gas emissions (Figure 3).

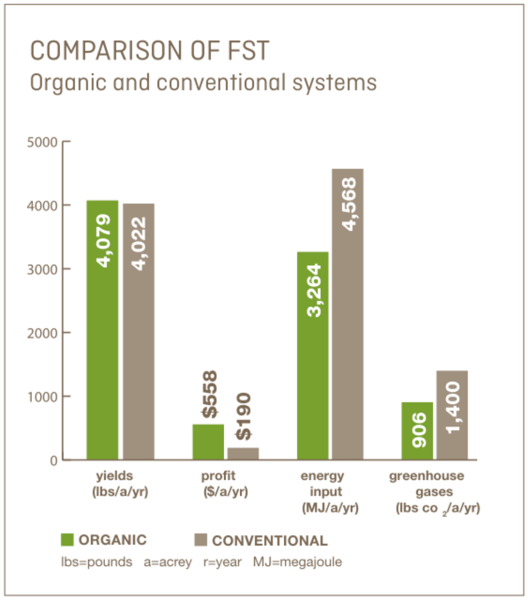

Fig.3 Comparison of the benefits of Farming Systems Trial (FST)

(here 'organic' means regenerative organic farming)

2.2 South Dakota State University's comparative study of agricultural patterns for corn

As an important food crop, corn occupies an important position in the world, with its planting area accounting for 39.9% of all crop areas. In order to explore the multiple impacts of regenerative agriculture on corn fields, Claire et al carried out trials of regenerative agriculture on 40 fields on 10 farms in the northern plains of the United States, with practices including no-till, cover crops (2-40 kinds), using no pesticides, and grazing livestock in the fields. By contrast, conventional farming practices (36 fields on eight farms) include continuous tillage every year, pesticide application and bare land during idle periods.

The researchers assessed the relative impact of regenerative and conventional maize production systems on pests, soil, and farmers' profits, and found that insecticide-treated maize fields had 10 times as many pests as non-insecticide regenerative farms, suggesting that the rich biodiversity of regenerative farms had a significant inhibiting effect on pests. Figure 4 showed the costs and benefits for the regenerative agriculture and conventional agriculture mode on the cornfields. For conventional agriculture, the cost of seed and fertilizer accounted for 32% of total revenue, yet for regenerative agricultural mode, it only accounted for 12% of total revenue. Adding the significant increase in the income of meat products on the regenerative land, the final net profit by adopting regenerative mode was improved by 78% compared with conventional agriculture. Also, this study saw a significant positive correlation between profit and soil organic matter content. And the increased organic matter (mainly through cover crops and holistic grazing) increased water permeability and promoted biodiversity, which in turn inhibited the reproduction of single pests and promoted soil health.

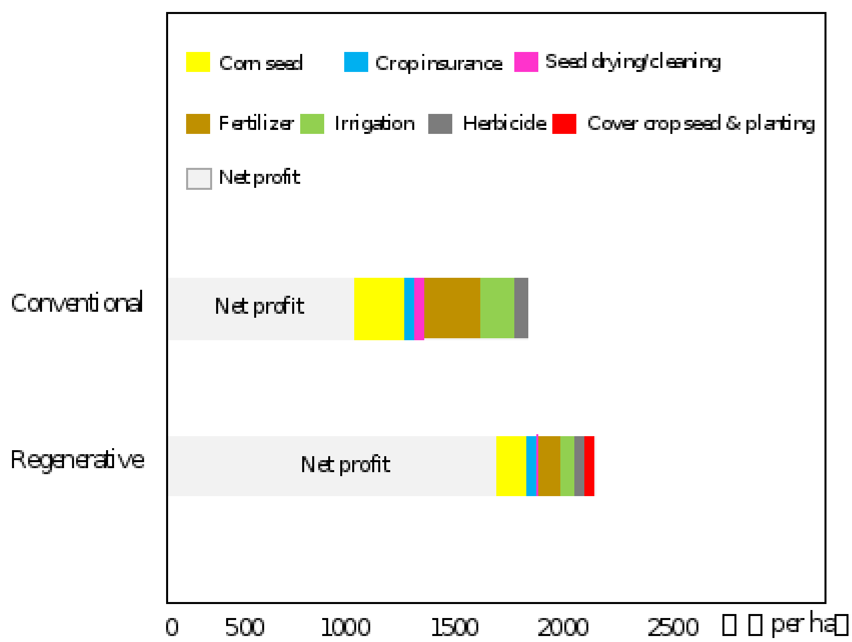

Fig.4 Revenue and cost of regeneratively and conventionally managed corn fields

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