The Positive Impact of Natural Farming on Water Body, Soil, and Atmosphere

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Abstract:Natural farming is an agricultural production method that maintains the natural growth state of crops to the largest extent. Natural farming reduces human's interference with the growth of crops and advocates respect for nature and conformity to the law of nature. Chinese natural farming features five core principles: (1) no pesticide (2) no fertilization (3) no weeding (4) self-retaining seeds (5) continuous cropping. This study is a relatively macro level research, and it comprehensively investigates the positive impact of natural farming on three components of the environment--water body, soil, and atmosphere--thus confirming the sustainability of natural farming. Researching on natural farming's positive effect on the environment will not only enable people to have a deeper understanding of this agricultural production method, but will also promote the further spread and dissemination of natural farming.

1. Introduction

Since the 1900s, the global population has shown a trend of rapid growth. Due to its low productivity and low crop yield, traditional agriculture has been unable to meet the needs of the world's population for food. Therefore, the era of modern agriculture has begun. Modern agriculture, an agricultural system featuring the use of chemical fertilizers, pesticide, herbicide, fungicide, etc., significantly increases productivity and thus the overall crop yield. However, while meeting food needs, a variety of severe environmental problems and food safety issues are its direct consequences. For example, the excessive use of chemical fertilizers could lead to fertilizer runoff, which would cause the phenomenon of eutrophication in water bodies including rivers, lakes, and oceans; while killing pests, weeds, and pathogenic bacteria, the overuse of pesticide, herbicide, and fungicide would also eliminate certain beneficial microorganisms. In addition, when pests develop resistance to pesticide over a period of time, famers have to increase the dosage, contributing to the vicious cycle of pesticide treadmill. Furthermore, in terms of food safety issue, residues of pesticides and chemical fertilizers in food are likely to make people chronically poisoned.

Because modern agriculture is in conflict with the ideal of sustainable development, human beings need to seek a more sustainable agricultural production system, namely organic agriculture. According to organic agriculture's very definition, no chemical fertilizers, pesticides, or growth regulators are used in the production process, but organic fertilizers are utilized in order to meet the nutritional needs of crops. Organic fertilizers mainly come from plants and animals, including manure, compost, straw, fallen leaves, animal carcass, slaughterhouse waste, etc. Although organic

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agriculture does help alleviate a series of environmental problems posed by modern agriculture, such as soil erosion, the pollution and energy consumption caused by the manufacture of chemical fertilizers and pesticides, pollution of surface and subsurface water supplies etc., it still has many shortcomings, especially in the process of making organic fertilizers. To be more specific, untreated or unsterilized manure may contain a large number of harmful bacteria such as Escherichia coli. Animal carcasses and plant residues may contain heavy metals. Once these harmful bacteria or heavy metals come into contact with crops, food safety issues will come along. In addition, the process of composting would release a large amount of greenhouse gases, such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), all of which are the major culprits of global warming.

Therefore, mankind needs an agricultural system that is much more environmentally friendly and could better meet the ideal of sustainable development, namely natural farming. Mokichi Okada first proposed the concept of natural farming in 1935, and Masanobu Fukuoka proposed the concept later in 1938. The real essence of natural farming lies in the word “natural” itself. That is, instead of attempting to control or intervene in nature, natural farming complies with the law of nature, and it fully respects and utilizes the infinite power of nature. Different from Japanese natural farming, the theoretical basis of Chinese natural farming comes from the Taoist classic “Tao Te Ching”. It is written in the book that Man’s laws should follow natural laws, just as nature gives rise to physical laws. And, Man takes his law from the Earth; the Earth takes its law from Heaven; Heaven takes its law from the Tao; Tao takes its law from the nature. In agricultural production, many aspects of “Man” are determined by the conditions of the “Earth”, or “land”, on which they live; many conditions of the “land” are determined by the local climatic conditions, and the climate follows the law of nature. So, in natural farming, the three major components--”Man”, “Earth”, and “Heaven” -- are indispensable.

2. Five Core Principles of Natural Farming:

Natural farming maintains the natural growth state of crops to the greatest extent, reduces human’s interference with the growth of crops, and advocates respect for nature and conformity to the law of nature. There are five core principles of Chinese natural farming, as follows:

(1)No pesticide

No chemical pesticides are utilized. Unnatural behavior or human intervention for the purpose of repelling insects is forbidden.

(2)No fertilization

Do not use any chemical fertilizers, mineral fertilizers, or even organic fertilizers.

(3)No weeding

Instead of eliminating all the weeds, natural farming advocates mowing the weeds.

(4)Self-retaining seeds

Try to use native, local varieties as much as possible and do not use any chemical or biological treatment on the seeds. Retain those seeds that are healthy and vigorous while also ensuring the diversity of seeds.

(5)Continuous cropping

Instead of crop rotation, natural farming advocates the use of continuous cropping because continuous cropping enables crops and land to cultivate a relationship of mutual adaptability. A single variety of crop should be planted in the same plot of land over time. When the climate is not suitable for planting the crop, farmers should let the land lie fallow.

3. Three Research Questions:

Natural farming effectively alleviates the environmental problems brought about by modern agriculture and organic agriculture. Therefore, researching on natural farming's positive effect on the environment will not only enable people to have a deeper understanding of this agricultural production method, but will also promote the further spread and dissemination of natural farming.

(1) The positive impact of natural farming on water bodies

The water quality of Qiandao Lake, which is located in Chun'an County, Hangzhou, Zhejiang Province, China, is first-class water, but after being used by farmers and discharged into the lake, the water quality becomes second-class water. The inferred reason is that the water discharged from modern agricultural farmlands contains a large number of chemical fertilizers, pesticides, herbicides, and fungicides. Apart from water discharged from modern agricultural farmlands, water discharged from organic agricultural farmlands also contains residues of manure. All of the substances mentioned above would contribute to the pollution of surface water bodies like lake. On the contrary, natural farming prohibits the use of all industrial chemicals and manure; therefore, there will be very little, if any, non-point source pollution to water bodies. This research project will confirm this inference.

Furthermore, the chemical fertilizers and pesticides used in modern agriculture will be likely to leach through the soil into the groundwater as water percolates downward, seriously polluting the subsurface water resources. This research project will also confirm that natural farming has nearly zero pollution to groundwater.

(2)The positive effect of natural farming on the soil

Both modern agriculture and organic agriculture advocate fine plowing of land. Fine plowing of the land seems to play a role in loosening soil and increasing air permeability, but it actually causes serious soil erosion and destroys the soil aggregate structure, which is not conducive to soil's water and fertilizer retention. However, natural farming advocates "no till" and believes that the natural power of the soil is adequate for crops to obtain sufficient nutrients. The reason is that when the roots of crops reach down deep into the soil, air and moisture also penetrate into the soil together with the roots. When crops wither and are finally decomposed by microorganisms, their decomposed roots, straws, and fallen leaves form rich organic matter called humus, which promotes the proliferation of beneficial microorganisms. Beneficial Abundant humus will attract earthworms. When the number of earthworms increases, the number of moles will correspondingly increase, thus further loosening the soil.

Furthermore, modern agriculture features spraying pesticides and herbicides to eliminate pests and weeds, but large-scale spraying of these two substances can cause serious soil erosion. Natural farming advocates the use of biological chains in nature to repel pests. According to experts in the field of natural farming, generally speaking, as long as there are no less than 40 biological species in the crop field, ecological balance will be achieved. When a stable state is reached, there will not be any mass reproduction of one single species.

For the treatment of weeds, natural farming advocates "mowing the weeds" until the height of the weeds is no higher than the height of the crops, so that they will not affect the photosynthesis of the crops. The mowed part of the weeds can be left in the field, which could be decomposed by microorganisms and then form abundant humus. The uncut part of the weeds is used to attract pests. Although seeming counter-intuitive, a lot of experiments and observations have confirmed that pests prefer wild weeds to crops; therefore, keeping the uncut weeds in the field would shield crops from the onslaught of pests to some extent.

This research project will confirm the protective and restorative effects of natural farming on the soil.

(3)The positive effect of natural farming on the atmosphere

Pesticides and chemical fertilizers utilized in modern agriculture are mostly manufactured from

synthetic compounds. Manufacturing and transporting these two substances would consume a tremendous amount of energy and emit a large amount of greenhouse gases such as carbon dioxide (CO_2). Therefore, modern agriculture is one of the major contributors to global warming. In addition, although organic agriculture prohibits the use of chemical fertilizers and pesticides, the process of composting also emits a large amount of methane (CH_4) and nitrous oxide (N_2O).

This research project will prove that natural farming will emit a very small amount of greenhouse gases and air pollutants.

4. Experiment Methods:

(1)The positive effect of natural farming on water bodies

Under the same other conditions, three experimental fields, each with an area of one hectare, are selected, and each experimental field is located in the upstream area of a specific river tributary. Each tributary does not communicate with each other. To be specific, experimental field 1 is located in the upstream of tributary 1; experimental field 2 is located in the upstream of tributary 2; experimental field 3 is located in the upstream of tributary 3. Experimental field 1 uses modern agricultural farming methods to grow wheat; experimental field 2 uses organic farming methods to grow wheat; experimental field 3 uses natural farming methods to grow wheat. Measure the concentration of chemical fertilizers, pesticides, herbicides, BOD (biological oxygen demand), DO (dissolved oxygen), E. coli concentration, and heavy metal concentration (Pb, Hg, Cd, Se), pH, nitrate concentration, phosphate concentration, turbidity in the downstream waters of each tributary. Then compare these indicators of each tributary. Apart from measuring the above indicators, researchers can also compare the number of water pollution indicator species (such as stone flies) in each tributary.

(2)The positive effect of natural farming on the soil

Under the same other conditions, three experimental fields, each with an area of one hectare, are selected. Experimental field 1 uses modern agricultural farming methods to grow wheat; experimental field 2 uses organic farming methods to grow wheat; experimental field 3 uses natural farming methods to grow wheat. The soil compaction, water holding capacity, nutrient holding capacity, pH, soil pore size, and the number and diversity of microbial flora of each experimental field are measured every three months.

(3)The positive effect of natural farming on the atmosphere

Under the same other conditions, three experimental fields, each with an area of one hectare, are selected. Experimental field 1 uses modern agricultural farming methods to grow wheat; experimental field 2 uses organic farming methods to grow wheat; experimental field 3 uses natural farming methods to grow wheat. The carbon dioxide (CO_2) concentration, methane (CH_4) concentration, sulfur dioxide (SO_2) concentration, nitrous oxide (N_2O) concentration, particle diameter and concentration, temperature and humidity above each experimental field are measured every three months. In addition to measuring the above indicators, researchers can also compare the number of air pollution indicator species (such as moss) in each experimental field.

5. Conclusion:

(1)Natural farming fields will not have any surface runoff of pesticides and chemical fertilizers, so fields using this farming method will cause very little, if any, non-point source pollution to water bodies. For the same reason, there will not be any pesticide or chemical fertilizer infiltrating into the groundwater, so natural farming also effectively protects the groundwater resources.

(2)The use of natural farming will not cause soil erosion or soil compaction. It will not only increase the organic matter like humus in the soil, but will also promote the reproduction of

beneficial microorganisms. The “no weeding” principle of natural farming will also increase the fertility of the soil and provide rich nutrients for crops.

(3)Compared with modern agriculture and organic agriculture, natural farming emits a smaller amount of greenhouse gases, effectively alleviating global warming. In addition, natural farming hardly discharges air pollutants into the atmosphere.

This project is a relatively macro level research. It comprehensively analyzes the positive impact of natural farming on environment in terms of three aspects: water body, soil, and atmosphere, thus confirming the sustainability of natural farming.

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