Current Implementation and Experience of Natural Farming in Japan

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Abstract The natural farming in Japan mainly includes Mokich Okada's natural farming theory and Masanobu Fukuoka's natural farming theory in terms of genre. Natural farming was proposed and implemented to deal with the anabatic soil degradation and food safety problems. Among them, Mokich Okada's natural farming theory advocates the restoration of the agricultural tradition of the past and combination with modern agricultural science and technology; Masanobu Fukuoka's natural farming theory advocates a complete return to natural and traditional farming and puts forward a set of green agricultural cultivation methods focusing on injurious insect control with beneficial insect, weed control with green herbaceous plants, soil reclamation with grass, nontoxic and cost-reducing method based on the Japanese ancient agricultural books. Their natural farming theories have been widely popularized and applied in Japan, and its successful experience is worthy of study and reference for China.

Key words Japan, Natural farming, Implementation experience, Reasonable reference for China

1 Introduction

Different from traditional agriculture, the agricultural labor productivity and land productivity of modern agriculture have increased significantly compared with the past. However, the substantial increase in productivity mainly depends on the continuous input of fossil energy and inorganic raw materials such as fertilizers and pesticides, which have an obvious impact on the natural environment and food safety. It can be said that the emergence of modern chemical agriculture has broken the ecological balance of nature. It increasingly exposes hidden dangers that are harmful to human living space and human safety while bringing high yield and high efficiency to human beings. As Japanese scholar Lemil Tsurumasa said, modern chemical agriculture has suppressed the instinct of life, wasted energy and destroyed the environment, so that the agriculture-organic life material production is turned into an industry-inorganic material production, bringing the rapid development of productivity but also causing the deterioration of the human environment[1].

The disadvantages of modern chemical agriculture in Japan were first discovered in the 1970s. The extensive use of chemical feeds, chemical veterinary drugs, and other chemical products led to the continuous emergence of environmental and food safety problems in Japan. Minamata disease (mercury poisoning), cadmium-polluted rice incidents, and direct or indirect poisoning incidents in various places were frequently reported in newspapers. As Japanese scholar Joxiu Yosun said, in rural areas, parasitic diseases are decreasing, while new diseases such as greenhouse disease and pesticide poisoning are increasing. Food additives, chemical seasonings, and pesticide residues are all adverse consequences caused by agricultural modernization. Modern agriculture is promoting technological progress in a suicidal way, which will cause an increase in environmental pollution and food-borne diseases. As a result, human beings have lost their natural curability and are on their way to destroying nature.[2]"

Modern chemical agriculture has also led to severe erosion of agricultural soil in Japan. Japan is one of the earliest countries in the world to use fertilizers and pesticides. After the Second World War, Japan transformed its armory into a fertilizer and pesticide factory, so fertilizers and pesticides were gradually applied in the whole countryside. In the 1980s, a large area of land in Japan was deserted, deteriorated, and died, because modern agriculture relies too much on fertilizers and pesticides. To control crop diseases and pests quickly and effectively, farmers usually apply a variety of highly toxic pesticides directly into the soil, resulting in serious pollution of the soil. The most direct consequence of the extensive use of fertilizer is that crops have a disorder of respiration and concentration, which further leads to the decline of soil fertility and the deterioration of soil physical properties, finally resulting in land desolation and the deterioration of crop quality. This is because pesticides and fertilizers will remain in the soil for a long time, which changes the soil microbial flora and leads to the extinction of many beneficial microorganisms. More importantly, a large number of highly toxic pesticides remaining in the soil not only degrades slowly but also enter the food chain of feed and food during the growth and development of crops, which will bring harm to the health of animals and human beings.

To get rid of the dilemma caused by chemical agriculture,

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many countries in the world have created many new agricultural farming methods since the middle of the last century. In addition to natural farming in Japan, there are vertical farming, organic farming, regenerative farming, alternative farming, microbial farming, *etc.*, all of which belong to the category of natural ecological agriculture in essence. Because their basic idea is to maintain the natural ecosystem, pay attention to the purification and vitality of the soil, and create a good agricultural ecological environment for human beings.

2 Proposal and development of natural farming in Japan

2.1 Mokich Okada's natural farming To cope with the worsening problems of soil degradation and food safety, the Japanese agricultural historiography industry put forward the suggestion of the restoration of the agricultural tradition of the past and combination with modern agricultural science and technology[3], so new agricultural development concepts such as ecological green agriculture began to be deeply rooted in people's hearts, and natural farming came into being.

Mokich Okada pioneered natural farming in Japan and carried out experimental research on natural farming since the 1930s. After the 1940s, natural farming was piloted in Hakone and Izu and then gradually expanded to the whole country. Mokich Okada founded the World Salvation Church in 1950 established the Natural Farming Popularization Society and launched Natural Farming in 1953. When Mokich Okada died in 1955, his followers followed in his footsteps and set up 53 natural farming pilot sites and held natural agricultural products fairs all over Japan. MQC, a natural product circulation organization, was established in 1973. Ishigaki Island Farm in Okinawa and an affiliated farm in Nayoro, Hokkaido were established in 1979. Ohito Farm in Izu was established in 1982. In the same year, the International Research and Development Center for Natural Farming and MOA research institution were set up. Since the 21st century, Kawahara Tatsuo of the International Research and Development Center for Natural Farming has put forward the idea of building a natural recycling regional society according to natural farming. He believes that people today blindly pursue convenient access to abundant creature comfort and pursue mass production, consumption, and waste, which leads to negative problems such as environmental pollution and various diseases. Therefore, we should explore a lifestyle conforming to nature, which does not require us to be retro, but requires us to be kind to the creatures of nature. As Mokich Okada said, the law of nature is truth, and humans should respect and obey the law of nature.

Mokich Okada's natural farming theory was mainly based on the natural way to improve soil fertility rather than relying on fertilizers. Soil fertility in dry fields is improved by mulching with straw and weeds or applying natural compost; soil fertility in paddy fields is generally improved by mulching with straw; soil fertility in windy places is improved by shallow burying of straws (not too late). To achieve a high yield, a large amount of compost must be applied to keep the microorganisms in the soil active. In addition, astragalus membranaceus, oats, ryegrass, and leguminous crops are added for multiple crops as green manure, which is beneficial to fertility improvement. Special attention should be paid to the improvement of the soil fertility in rice seedling beds. Composts are taken locally, such as weeds along the riverbank, leftovers after fungus cultivation (including sawdust, bean dregs, rice bran, *etc.*), branches and fallen leaves, vegetable stems, bean stalks, and straw stalks, and used straw mats. To promote fermentation, starter cultures such as greaves and rice bran can be added. It is worth mentioning that Mokich Okada's natural farming does not reject agricultural mechanization. In its affiliated farms, machinery is used not only for planting seedlings, rice harvesting, and weeding but also for stacking and spreading composts[4]. In a word, the difference between Mokich Okada's natural farming and modern farming lies in that natural farming is to give full play to the role of soil and seeds based on the orderly biodiversity of farmland to improve the health of crops, to control disease pests and weed and achieving high yield with high quality; the modern farming relies on fertilizers, pesticides, and herbicides, and deals with problems on an *ad hoc* basis not on a sustainable way.

After the death of Mokich Okada, the World Salvation Society broke up. Mihideko Koyama was withdrawn from the Society and started MIHO natural farming. The original World Salvation Church was divided into three religious groups, namely "Light of the East", "Eye of Izu" and "Light of Lord". Although the successors took different development routes, they generally inherited the original idea of Mokich Okada: conform to nature and obey nature, advocate the use of compost made of fallen leaves and withered grass, and promote the cultivation method of self-seed collecting and continuous cropping. Among them, MIHO natural farming advocates a complete return to traditional farming, that is, it does not use plastic coverings and insists on self-seed collecting; "MOA natural farming" of Light of the East and the natural farming of Eye of Izu advocates flexible farming and do not exclude the use of black plastic film, plastic cloth, and other materials; compared with the natural farming of Light of the East, the natural farming of Eye of Izu also advocates the popularization of EM bacteria (a mixed flora beneficial to microorganisms) and devotes to the scientific empirical research on the natural farming[5].

2.2 Masanobu Fukuoka's natural farming Masanobu Fukuoka, another important practitioner of natural farming in Japan, developed the idea of "non-doing agriculture and wrote books such as *Natural Farming* and *The One-Straw Revolution* based on Lao Zi's inaction thought and Japanese "chaos philosophy". Masanobu Fukuoka believed that modern agriculture achieves high yield mainly depending on the application of large amounts of fertilizers, pesticides, and herbicides as well as the extensive use of machinery and other technologies. However, although the application of fertilizer can increase the yield, it will kill a large

number of soil microorganisms, leading to soil degradation; although the use of pesticides and herbicides can control pests and weeds, it will also indirectly destroy the balance of natural ecosystems; although the field plowing with machinery can temporarily achieve the effect of scarification and respiration, it will destroy the soil aggregate structure in the long run, which is not conducive to moisture and fertilizer conservation. To overcome the defects and disadvantages of modern chemical agriculture, Masanobu Fukuoka advocated returning to traditional and natural farming. The core of his experience can be expressed by the word "inaction", that is, no plowing, no fertilizing, no weeding, and no applying pesticides. He believed that all crops in the world grow in an orderly way according to their laws; after being processed by human beings, they will be changed from the natural form to the unnatural form, leading to disordered growth of branches and leaves and poor ventilation and light transmission. The competition between branches and leaves is fierce; the superior wins, the inferior loses, and some flourishes and some die. Once the branches are pruned, the natural conditions are destroyed. Originally, it was a tree performance formed by complemented branches and leaves, but it finally became a competition as the law of the jungle[6]. The same is true in agricultural activities; plowing, sowing, intertillage, weeding, and pest control are all not essential. The reason why people carry out winter tillage is that people take it for granted that winter tillage can loosen the soil to maximize fertilizer efficiency. However, after repeated plowing in paddy fields, soil particles are dispersed and air overflows, so that the soil becomes solid. To improve the destroyed soil, winter tillage is carried out to loosen the soil in time. It can be seen that scientific farming focuses on correcting and improving natural defects through artificial interferences. However, natural farming aims to investigate the causes of its defects and tries to avoid human interference[7].

The essence of Masanobu Fukuoka's natural farming is to keep the most natural and beneficial farming mode of agriculture without a lot of labor. On the surface, it seems extensive, but in essence, it is a rigorous and unique mode. Its theoretical basis stems from the inaction thought of China Lao Zi and Zhuang Zi, that is, "Saints and sages should take inaction as the key thought in dealing with affairs, and civilize people in a silence way; letting everything develop in their natural course without finding its source, providing helps but not imposing your ideas". No plowing, no fertilizing, no weeding, and no applying pesticides are the four major principles of this farming; injurious insect control with beneficial insects, weed control with green herbaceous plants, and soil reclamation with grass are the important characteristics of this farming, so it is in sharp contrast to the modern farming. Masanobu Fukuoka has won the International NGO, the Earth Council Award, and other awards, commending his successful practice in "providing farmers all over the world with a practical method to protect the safety and avoid the harmful consequences of modern production activities".

3 Experience and implications of Japan's natural farming

3.1 Improving laws and regulations The Japanese government attaches great importance to the activities related to natural farming, vigorously promotes the construction of organic agriculture and ecological agriculture, and effectively standardizes them by improving relevant policies and regulations. N*atural farming in Japan* was legislated in the 1970s, namely, the *Agricultural Banning Law and the Soil Pollution Prevention Law*, which brought environmental protection and pollution prevention to the forefront of people's minds. After the 1990s, much legislative work was carried out. The *New Direction of Agricultural* and *Rural Policy on Food* was promulgated in 1992; the *Basic Law of the Environment* was promulgated in 1993. On this basis, the *Charter for Promoting Environmental Conservation Agriculture* was formulated in 1997. In 1999, the *Sustainable Agriculture Law* was promulgated, which put forward the concept of ecological farmers. In 2001, the *Law of Promotion of Ecological Agriculture* was promulgated to formally implement the labeling system of organic agricultural products. In 2004, the *Pesticides Banning Law* was revised to strictly formulate the standards for pesticide residues. The year 2005 was the peak year for the legislation work on natural farming, with a total of nine policies, regulations, and industry standards launched. They are *Japanese Agriculture Standard for Organic Agricultural Products*, *Japanese Agriculture Standard for Organic Seeds*, *Japanese Agriculture Standard for Organic Animal Products*, *Technical Standards for Certification of Domestic or Foreign Production and Processing Managers of Organic Agricultural Products and Organic Seeds*, *Technical Standards for Certification of Domestic or Foreign Production and Processing Managers of Organic Processed Foods and Seeds*, *and Technical Standards for Certification of Domestic and Foreign Production and Processing Managers of Organic Animal Products*, *Circulars and Technical Standard for Certification of Importers of Organic Agricultural Products and Organic Processed Foods*, *Inspection Methods for Production and Processing of Organic Agricultural Products*, *Organic Processed Foods*, *Organic Seeds and Organic Animal Products*, *and Technical Standards for Certification of Domestic and Foreign Repackers of Organic Agricultural Products*, *Organic Processed Foods*, *Organic Seeds and Organic Animal Products*[8]. In 2009, the *JAS Law* was revised to clearly state the relevant punishment measures for food vendors who tamper with the origin mark. In 2015, the *Law on Promoting the Diversified Functions of Agriculture* was promulgated to further promote the construction of laws and regulations on natural farming[9]. So far, the legislative work related to natural farming has been completed.

It can be seen from the above that the legal system of natural farming has been established and improved in Japan in the past 50 years, which has laid a solid legal foundation for the healthy development of natural farming. Japan's experience demonstrates to us that we can adapt to the new changes in agricultural development only by constantly introducing new laws, revising old laws,

resolutely advancing agriculture development according to law, and raising the cost of violation. Only by constantly improving and perfecting the legal system of the agricultural environment and food safety protection can we promote the development of organic ecological agriculture according to the laws, can people consciously protect the environment and prevent pollution.

3.2 Building a scientific and practical technology system With many years of practice, a set of green agricultural cultivation methods focusing on injurious insect control with beneficial insects, weed control with green herbaceous plants, soil reclamation with grass, and nontoxic and cost-reducing methods has been explored by the natural farming industry. As mentioned above, natural farming in Japan advocates no plowing (natural growth without any tillage) due to the fact plowing will destroy the aggregate structure of the soil, which will lead to the imbalance of soil fertility and heat. The idea of natural farming is that the roots of plants can loosen the soil naturally without destroying the aggregate structure of the soil. Besides the "biological plow" of the plant, the "biological plow" of the animal can also loosen the soil, and the natural farming industry advocates the natural soil improvement effect of earthworms. Meanwhile, natural farming in Japan also advocates mulching with straws instead of applying fertilizer. The heavy application of fertilizer will lead to soil hardening, which will increase the workload of winter tillage later. Mulching with straws can keep the soil moist and promote the stabilization and homogenization of heat conditions, thus improving the potential of increasing yield with organic fertilizer. What's more, natural farming in Japan advocates no pesticides but utilizing the principle of mutual generation and restriction of all things in nature to prevent and control crop diseases and pests, For example, leek is intercropped with Chinese cabbage to prevent Chinese cabbage from root rot; corn is intercropped with Chinese cabbage to reduce the soft rot of Chinese cabbage; *Robinia pseudoacacia* is planted around fruit trees to effectively control aphids and scale insects. Of course, the main purpose of not pesticides is to maintain ecological balance. Fields without pesticides will naturally form a natural enemy protection circle, with dragonflies on the top, spiders in the middle, and frogs at the bottom, so as to effectively control the spread of pests. Finally, natural farming in Japan advocates no weeding, because it believes that weeds can increase the total photosynthesis per unit area and increase the organic matter in the land. Therefore, as long as weeds do not compete with crops for fertilizer and light, it is not necessary to weed. If weeds affect crop growth, it is advocated to utilize the natural law that plants are complementary to each other to "eliminate weeds with weeds". Natural farming has proved that leguminous plants such as clover, alfalfa, and Chinese milk vetch can effectively squeeze other weeds out, and can fix nitrogen and increase soil fertility.

In the 1980s, Masanobu Fukuoka's natural farming in Japan was introduced into China, which led to significant reforms in cultivation techniques in China. With more than 30 years of development, the primary natural farming with China characteristics has begun to take shape. Lu Ming, the former vice minister of the Ministry of Agriculture, believes that the simpler the technology, the higher its scientific and technological content[10]. This conforms to the law of scientific development, that is, farming is developed from simple to complex technology, and then returns to simple technology.

3.3 Improving the natural farming business model In the process of promoting natural agriculture in Japan, in addition to government sectors such as the Ministry of Agriculture, Forestry and Fisheries, all levels of society, including the Japan Agricultural Association, Japanese universities, relevant scientific research institutions, farmers and consumer groups, have actively participated in the promotion and management of natural agriculture. After long-term cooperation, a four-in-one cooperative operation mechanism of "Industry, Official, University and Consumer" has formed. This operation mechanism can be understood as follows: The administrative department of agriculture leads and drives the development of new agricultural formats by promulgating policies and regulations. In addition, the agricultural associations, universities, scientific research institutions, consumer groups, and other participants fully play their role through undertaking entrustment, project entrustment, joint communication, and other forms; the cooperative effect is fully brought into play by relying on collaborative promotion to achieve the win-win situation for many parties[11]. Specifically, universities and other scientific research institutions provide theoretical and decision-making basis for the government to promote the natural agriculture through the commissioned project research set up by the Ministry of Agriculture, Forestry and Fisheries, and also put forward suggestions and opinions for the formulation of laws and regulations on the circulation of natural agricultural products; the agricultural associations at all levels actively build an integrated service system in terms of agricultural materials distribution, technical guidance, market development, product sales, information feedback, *etc.* through investigation and problem analysis, which solves the worries of farmers to some extent; producers enhance consumers' confidence in natural agricultural products by establishing an integrity guarantee system, and then open the door of "Customized Service"- high-end agricultural product consumption market, creating a development model of high-integrity agriculture.

Japan's experience shows that it is not enough to promote natural agriculture only by government investment and farmers' participation, but also by the extensive participation and cooperation of all levels of society, including industry associations, universities, scientific research institutions, and consumers. Drawing lessons from Japan's experience, China should also actively explore multi-party cooperation mechanisms, focus on building a community of shared interests, and constantly seize the commanding heights of eco-industry brands through measures such as keeping honesty, setting high positioning and wide layout, striving for first-class service, and channel introducing, which is of great significance for realizing the natural agriculture with China characteristics and

socialist agricultural modernization.

4 Reference and practice of natural farming in China

After the new concept of natural farming in Japan was introduced in the 1980s, natural farming has been implemented in many places in China. Drawing lessons from the technology of "ultra high-stubble wheat (rape) interplanted with rice" in Fukuoka Agricultural Park, Japan, and referring to the experience of wheat interplanted with rice that has been studied in China, Yangzhou Academy of Agricultural Sciences of Jiangsu Province focused on exploring a new farming and cultivation technology system that combines no-tillage interplanting rice with full natural mulching of machine-harvested straw turnover in the early 21st century. Under the new situation of agricultural structure adjustment, this technology was further applied in the development and application of interplanting rice in rape fields, and the primary natural farming with China characteristics-"low-carbon rice interplanting technology" was formed. Low-carbon rice interplanting technology refers to spreading the treated rice seeds directly to the three-kind wheat (rape) field in the middle and late stage of three-kind wheat grain filling (rape pod). When wheat and rape are harvested, the high stubbles are left to stand naturally, and the threshed straw and rapeseed shells are scattered locally and buried in the dead furrow or natural strip nearby for natural decomposition, which is a high-yield, high-quality, efficient, ecological and safe light rice cultivation[12]. Based on this, Jiangsu Administration for Market Regulation revised the local standard of symbiotic wheat interplanting rice in Jiangsu Province in 2005, formulated the local standard of symbiotic rape interplanting rice in 2006, and formulated the local standard of interplanting direct-seeding rice without the symbiotic period in 2010.

Compared with the mechanical plowing and interplanting technology in developed countries, the low-carbon rice interplanting technology developed in China based on natural farming has the important characteristics of no-tillage, no-transplanting, no-burning straw, full natural mulching, saving fertilizer, saving cost and increasing income; in addition, it does not use the special mechanical equipment, so energy consumption and raw material consumption are reduced. The costs are saved as follows: Compared with machine-transplanted rice, the production cost per mu can be saved by more than 300 yuan, the cost can be saved by 95.8%, and the water and electricity management fee, fertilizer fee, and pesticide fee can be saved by 57.8%, 30.4%, and 23.6% respectively. Compared with machine-transplanted rice, the net income per mu of interplanting rice in ultra high-stubble wheat fields interplanted with rice is 487.5 yuan higher[13]. The energy consumption in the following aspects is reduced: Diesel oil is saved by about 2.5 kg and emissions are reduced by 8 kg (3.186 kg per kg) due to no-tillage; gasoline for machine transplanting is saved by 0.4 kg of and emissions are reduced by 1.23 kg (3.08 kg per kg) due to no-transplanting; fertilizer is saved by 20% and emissions are reduced by 18.3 kg (2.1 kg of carbon dioxide is generated per kilogram of urea); compared with mechanical rotary burying, mulching with straws can reduce methane emission by 65% and carbon dioxide emission by 777.5 kg; compared with the open burning of straws, it is unnecessary to burn about 6 000 kg/ha of straw per season due to the low-carbon rice interplanting technology, and emissions can be reduced by 720 kg (1.8 kg)[14]. Straw is a valuable natural resource. As an organic matter with high fibrosis and lignification, straw is beneficial to the accumulation of soil organic matter and is a high-quality material for improving soil fertility due to its low decomposition speed. Masanobu Fukuoka, the founder of natural farming in Japan, regarded the straw turnover as a revolution; mulching in full for decades has realized natural cultivation without using fertilizers and pesticides[7].

Since the 21st century, China has borrowed extensively the experience of natural farming in Japan. The above examples show the reference and practice of the Yangzhou Academy of Agricultural Sciences of Jiangsu Province for the no-tillage cultivation and straw mulching technology in natural farming. For the implementation effect, natural farming has played an important role in improving soil fertility, saving costs, and increasing income. However, problems in the practical application and popularization of related technologies have been found, mainly including weed and pest control in rice fields[13]. To solve these problems, agricultural research institutes in China have taken the measures of "weed control with green herbaceous plants (control weeds with clover) and injurious insect control with beneficial insect (control injurious insects with their natural enemy) in the natural farming in Japan and carried out multiple agricultural experiments. In fact, in addition to Jiangsu Province, Shandong, Zhejiang, Jiangxi, Hainan, and other provinces have also set up demonstration bases of natural farming, and actively carried out natural farming experiments from paddy fields to orchards[15]. Compared with Japan, the research activities in China are still in the primary stage. In a relatively long period of time, farmers in China still need to learn the advanced experience of natural farming from developed countries such as Japan. Through a large number of experimental studies, researchers can analyze the technologies to be localized and measures directly introduced and applied in current ecological agriculture in China. It is believed that relying on China's historical experience of organic farming for thousands of years and the ingenuity and wisdom of the people of China, the path of natural farming with China's characteristics and suitable for China's national conditions will be further and wider.

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industrial clusters and accelerating the development of woody oil industry Hubei Province should take Wuling Mountain, Dabie Mountain, Qinba Mountain and Mufu Mountain as the core areas, build the whole industry chain of woody oil, strengthen the guidance of scientific and technological innovation, cultivate new momentum of industrial development, and build the regional brand of woody oil. It is recommended to build relevant national agricultural modern industrial parks and strong towns of agricultural industry. Hubei Province should promote the upgrading of industrial form from "small specialty" to "big industry", the transformation of spatial layout from "plane distribution" to "cluster development", the transformation of main body relationship from "homogeneous competition" to "win-win cooperation", and create a national characteristic industrial advantage area and industrial cluster with reasonable structure and complete chain of woody oil industry in Hubei Province. Combined with the strategy of strengthening the country with intellectual property and the strategy of rural revitalization, it is necessary to accelerate the development of the woody oil industry and ensure the security of the important industrial chain and supply chain of vegetable edible oil.

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