

Research on the Implementation and Disappearance of the Field Law in the Western Han Dynasty

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Abstract: The method of replacing farmland was invented by Zhao Guo, an agronomist of the Han Dynasty, based on the experience of his predecessors. The implementation of the land substitution law increases agricultural productivity and significantly improves the yield of each acre. The Dai Tian Law played an undeniable role in the restoration of social and economic development during the Han Dynasty. This article organizes and summarizes relevant theoretical books and papers, and conducts comparative research. The paper mainly elaborates on the implementation background of the land substitution method, introduces the implementation process of the land substitution method, analyzes the reasons for its increase in production and disappearance, and provides valuable experience for the development of agriculture.

1. Introduction

In ancient China, there was a production method of replacing farmland, which was based on the growth characteristics of crops in the geographical environment and natural laws for production and cultivation. It is not only conducive to maintaining ecological balance, but also reflects the changes in agricultural technology under the social and political background. Specialized research on the Daida method was relatively rare in previous academic studies. For example, "On the Motivation of the Implementation of the Land Substitution Law - Simultaneously Discussing the Inheritance and Development of the Land Substitution Law on the Farmland System" (Agricultural Archaeology), Issue 4, 2020, "The Land Substitution Law of the Western Han Dynasty - Investigation of the Background and Influence of Its Implementation" (Heilongjiang Historical Records), Issue 23, 2010, etc. It mainly focuses on the specific practice of the land substitution method, lacking analysis of issues such as the non-popularization of the land substitution method. This article attempts to reinterpret the traditional farming technique of land substitution, examine the reasons for its disappearance, and pay more attention to the evolution of agricultural technology.

2. Background of the Implementation of the Dai Tian Law

During the reign of Emperor Wu, due to voluntary and forced migration, the population size of the Guanzhong area expanded unprecedentedly. "In today's affairs, there is a severe challenge of prohibiting violence, imposing taxes without authorization, and benefiting farmers."^[1] Adequate

food supply has become a serious problem.

As the first organized and large-scale promotion of a new agricultural technology in the country, the land substitution method has the characteristics of wind prevention and drought resistance, suitable for large-scale land cultivation, and equal labor and income exchange between furrows and ridges. In addition to pursuing high crop yields, it was also directly related to the agricultural development of the border counties at that time. Secondly, the Han Dynasty and the Xiongnu people engaged in continuous wars, and the Han Dynasty urgently needed a large number of horses for wartime needs. However, the Xiongnu strictly controlled horses, so the Han Dynasty had to increase its own horse breeding. The field substitution method can increase grain production and feed horses for war preparation, reducing military expenditure.

3. What is the Daida Method

Zhao Guo's method of replacing farmland improved the ridge method of "abandoning mu in the upper field and abandoning mu in the lower field,"^[2] with the main content of "one mu, three mu, and the year's generation,"^[3] where "mu" is "ping". That is to say, dividing one acre of land into three ridges at each step, with two ridges between the three ridges, and adding a ridge on the edge of the step, there are three ridges corresponding to the three ridges (in the Han Dynasty's field system, if one acre of land was measured directly, it would be one horizontal step and 240 vertical steps; if measured square, it would be fifteen horizontal steps and sixteen vertical steps; the numbers obtained by these two algorithms are 240 square steps per acre. The length of each step is six feet). According to the Daida Law, each ridge is one foot wide, calculated in steps of six feet, and it happens that each ridge is also one foot wide; The depth of the bark is one foot. Due to the arid region of the Yellow River Basin in the north, with less rainfall and frequent strong winds in spring, the soil can maintain a certain temperature and humidity during sowing, which is beneficial for the growth of seedlings. Therefore, seeds are sown during spring sowing; The ridge is like a resting place, allowing its wild grass to fertilize. At the time of intercropping and weeding, the rice seedlings have already grown three or more leaves. At this time, the weeds on the ridge should be weeded out slightly, and the fertile soil that has been raised with weeds on the ridge should be shoveled down and cultivated on top of the soil covering the rice seedlings in the field. On the one hand, it can not only strengthen the seedlings with fertile ridge soil, but also make the roots of the rice seedlings adhere more firmly to the thick soil, which can withstand the common strong winds in the northern spring and summer seasons. In the future, every time the grass is weeded, the ridge soil will be removed to cultivate seedlings. In the middle of summer, the ridge soil has been leveled, while the valley seedlings in the field have been deeply rooted and leafy due to continuous cultivation, capable of resisting strong winds and droughts, and growing well. In the harvest season, as the ridge soil is constantly being shoveled and piled up into the bark, the bark becomes a ridge, and the ridge becomes a bark. In the following year, it can be planted in the bark that was originally a ridge, while the already cultivated bark is used as a ridge to rest and grow grass for fattening. In this way, according to the order of cultivation and recuperation, the land is changed once a year, and the three hills and three ridges of each acre of land are circulated every three years; Due to the annual exchange of paddies and ridges, it is called the 'Dai Tian Law'.

4. No Need for Excessive Ground Temperature

The main heat source for soil temperature comes from solar radiation. A small portion of it is the biochemical heat generated by soil microorganisms when decomposing organic matter, as well as the radiation heat and heat generated by thermochemical reactions within the Earth. But compared to the radiant heat of the sun, everything else is insignificant. Due to the obstruction of plants, it is

impossible for sunlight to directly shine on the ground in Mantian. Therefore, the ground temperature is relatively low. Daitian sows seeds in the ditch, with no seedlings on the ridge, and the sun can directly shine on the ground; Even in the midsummer when the valleys are flat, half of the fields are directly illuminated by the sun. The ground temperature of Daitian is undoubtedly much higher than that of Mantian. The ground temperature under this condition is conducive to crop emergence, early onset, and rapid growth.

Zhao Guo was in the place of "leaving the palace" when he implemented the field replacement method. The history says that "(Zhao) tried to leave the palace to die in the field of more than one mu of bamboo", which is also called Wuzuo Palace. The Book of the Han Dynasty records that "its shade covers several mu." Zhao Guo implemented the field replacement method here, because the shade of trees here can increase the yield of millet.

5. Light Energy Utilization Rate

The substitute crops have a wide empty strip, which increases the light transmittance between plants and greatly improves the lighting conditions in the field. Crops are not only illuminated by flat lighting at the top, but also by lateral light on the middle and lower leaves. The photosynthesis of middle and lower leaves is often above the compensation point, which greatly increases the functional leaves of plants. The flat lighting of the crop population has transformed into three-dimensional light, which includes both flat and side lighting, and also utilizes the diffuse light refracted by the sun on the ridges. In addition, the supply of carbon dioxide is good, and the Photosynthetic efficiency is improved. Photosynthate is fast and abundant, so it is inevitable to increase production. In short, the substitution method also improves the utilization rate of light energy and is conducive to the accumulation of dry matter.

6. Invention of Auxiliary Tools

When implementing the land replacement law, although only half of the land is cultivated annually, the fallow land can still provide fertilizer for the cultivated land. Therefore, it has actually improved the efficiency of farmland use and increased unit yield. More importantly, Zhao Guo invented and promoted a more efficient farming method called "coupled plow", which greatly improved the plowing ability of the plow. The existence of plow walls also facilitated plowing and ridging.

"For the people to make a living, one person plows and plows, but only ten acres."^[4] In the early Han Dynasty, the main farming method was still the use of manpower. "During the Zhou Dynasty, there was no cattle plowing, but during the Han Dynasty, Zhao Guo, the commander of Su Du, was searched and the people were taught how to cultivate cattle."^[5] By the time Emperor Wu of Han ascended the throne, cattle farming was still limited to wealthy households. Due to the fact that cow power is much greater than human labor, this method can plow the land deep and loose, which is more conducive to later cultivation. "Agriculture is the great cause of the world; Iron is a great tool for the people. Convenient tools require less effort and more effort, and farmers are happy to persuade others."^[6] With the widespread application of iron tools in agriculture, cattle farming technology continues to develop on the basis of coupled plowing. Decades later, in the late Western Han Dynasty, with the emergence of more advanced plowing tools, the "one man, one cow" farming method finally emerged.

In some places, "The terrain is warm and humid, not suitable for cattle or horses"^[7], Zhao Guo improved the mechanical "columbine" for planting. Before Zhao Guo, farmers used one legged or two legged plows for planting. It is speculated that the origin of the one-legged columbine may have been during the Warring States period when iron tools were widely used. In the early years of

the Western Han Dynasty, both single legged and two legged columbines were widely used, but their production efficiency was not high. Zhao Guo invented the three legged columbine, also known as the "columbine", based on these two types of columbines. According to the "Agricultural Book", "The columbine is a tool for sowing seeds... It is made with two handles that can be bent upwards, up to three feet high, two legs that are hollow in the middle, and a wide ridge that merges into one. The columbine is horizontally tested for four turns, with a columbine placed in the middle. The seeds it contains each have their own orifices. The columbine can still hold two shafts and hold an ox, and one person can lead it. The columbine is held by the other person, and the seeds are sown from below"^[8]

Zhao Guo vigorously promoted the use of manual plowing, teaching farmers to use this "manual plow" for farming through the method of labor exchange and cooperation. When using "manual plowing", if there are many people involved in plowing, they can plow 30 acres of land per day, while those with fewer people can also plow 13 acres, resulting in a significant increase in the area of cultivated wasteland.

7. Whether to Increase Production or Not

Ban Gu summarized the implementation effect of the Dai Tian Law with the phrase "less effort leads to more grain". Due to the clever layout of the farmland and the precise cultivation method, the substitute field method can prevent wind, withstand drought, and increase production. It is said in history that "one mu increases one mu", which should be a large mu.

Due to the greatly improved efficiency of the new farming methods, the area of land that farmers are capable of cultivating has also greatly increased. According to the system of "one well, one house" equipped with twelve farmers for cultivation, they can cultivate five hectares of land, equivalent to 1200 acres in ancient times, with an average of 100 acres of ancient farmland cultivated per person. Before the Han Dynasty, one acre of land was a "small acre", with only one hundred steps of land. During the reign of Emperor Wu of Han, the cultivation of "large acres" was officially implemented. One acre of land was 240 steps, and one acre was one hundred acres, so the five acre field was 1200 acres. In the Han Dynasty, one acre was about half of today's land. Before Zhao Guo promoted new agricultural tools, farmers used plowed land, with a maximum of less than ten acres of land to cultivate and an annual income of only forty stones. Therefore, based solely on the area of cultivation, the new farming method has increased its efficiency ten times. After adopting the coupled plowing method, the annual income is "often more than one mu per mu", which means that the income is more than one mu per mu compared to the field without using the substitution method. If it is a fertile field with good soil conditions, the harvest will be higher.

8. The Disappearance of the Daida Method

The implementation of the Dai Tian Law had a significant effect on the socio-economic recovery during the reign of Emperor Wu of Han. Especially in ancient Chinese feudal society, the promotion and use of new agricultural tools such as coupled plows and columbines, which were compatible with the land substitution method, took agricultural productivity to a new level. However, there are no traces of the implementation of the land substitution method in the book "The Book of Flood Victory" written in the later years of the Western Han Dynasty. During the Wei, Jin, and Southern and Northern Dynasties, the cultivation method of "spring plowing, searching for manual labor; autumn plowing, waiting for white back labor"^[9] was popular in the Yellow River Basin.

The reason for this is, on the one hand, that the substitution method requires higher cattle strength and agricultural tools, making it suitable for larger scale cultivation. However, in the feudal

society of China, agriculture, which mainly relied on decentralized small-scale farming, lacked adaptability to this situation. After reclaiming a large number of territories occupied by the Xiongnu, the Dai Tian Law lost its significance in stabilizing the production of border farmers. And after these lands were returned to the surrendered Xiongnu tribes, there were no cultivators in the Dai Tian Law. On the other hand, the method of replacing farmland is only one of the various agricultural technologies for wind and drought prevention in the Yellow River Basin. With the "heavy plowing and harrowing" measures being able to alleviate the spring drought problem in the Yellow River Basin to a considerable extent, there are few fields specialized in ridge and ditch planting.

The most crucial thing is to promote the land substitution method and the coupling plow, which will have a huge impact on the small-scale peasant economy. The land substitution method requires large-scale operation, which has sparked a wave of rural individual unit expansion. However, the feudal land ownership system continued to develop, the landlord's powerful power expanded, and the dependence on the labor group strengthened. The landlord, Tian Zhuang, served as a laborer who remained economically independent but had a serious personal affiliation. The land substitution method requires a large amount of manpower and cattle farming tools input, and tenant farmers rely on the labor of the landlords, without the need for intensive cultivation. During the Wei, Jin, and Northern and Southern Dynasties, despite the chaos of war, the landlord class still held the core land for agriculture in the north and south. The field replacement method cannot open up a new Lebensraum. After the more lightweight curved shaft plow was popularized in the plow, the main direction was to adapt to the small-scale peasant economy, from "two cattle and three people" to "two people and two cattle", and then to "one person and one cattle".

Finally, under the influence of national finance, the most important reason for the existence of the land substitution law has been lost. The continuous increase in grain production has led to "low grain prices hurting farmers", and the inability to retrieve currency has caused a financial deficit for the court. The government has further restricted the implementation of the land substitution law.

9. Conclusion

The substitution method has increased grain production. Although it has not been widely implemented for a long time, the advanced technology it contains is the crystallization of the wisdom of its predecessors and is inherited and absorbed by future generations. As a model of coordinated development between crop cultivation and ecological protection in ancient China, he promoted the development of agricultural technology and had a profound impact.

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