Why Chinese Agriculture Must Undergo an Ecological Transformation

When talking about contemporary ecological and agricultural issues in the world, the so-called 'Green Revolution' is a topic that inevitably arises and a topic with which China has a deep connection.[1] In the US government's 1949 White Paper on China, Washington attributed the Chinese Revolution to the country having too many people and too little land. Chairman Mao Zedong amply refuted such Malthusian historiography in his eloquent essay 'The Bankruptcy of the Idealist Conception of History'. However, Malthusianism would still dominate global approaches to development and social policy for a long time, and its immediate policy conclusion – that technological improvements in food production could solve the social/revolutionary problem – was the essence of the Green Revolution.

After the victory of the Chinese Revolution, the imperialist efforts to control China and the entire Third World suffered a significant blow. To counter the revolutionary wave in Asia, the imperialists turned their focus to another major Asian country, India. Paul Hoffman, administrator of the US Marshall Plan and president of the Ford Foundation in the early days of the Cold War, once observed, 'if in 1945 we had embarked [in India] on such a program [as the rural development program in Taiwan] and carried it on at a cost of not over two hundred million dollars a year, the end result would have been a China completely immunised against the appeal of the Communists. India, in my opinion, is today what China was in 1945'.[2] Hoffman's comments reflected the underlying motivation behind the Green Revolution, which, as is now widely recognised, was not truly 'green' or ecological but primarily aimed at distinguishing itself from the 'Red Revolution'.

Discussing ecological issues and the Green Revolution in the Chinese context can sometimes deliver a paradoxical experience. On the one hand, ecological civilisation has become central to the mainstream discourse in China thanks to the push by Chinese policymakers, and related terms such as emissions reduction, low carbon, and new energy have become very familiar to the general public. The general public prefers to buy green, pollution-free produce and even prefers to make their main food purchases at vegetable markets directly supplied by farmers. This deep-rooted awareness of ecological issues is perhaps remarkable on a global scale. Scepticism about the ecological transition and denial of the global climate crisis are invisible, at least at the official level in China. This is one of the direct benefits of China's long-term emphasis on and belief in science.

On the other hand, however, China's government and non-government sectors often have an ambiguous understanding of the meaning of ecological civilisation and ecological transformation. One of the most prominent points here, for example, is the perception of the Green Revolution. In China, the Green Revolution – or at least a part of it, the so-called hybrid high-yield crops – still has unshakeable support,

which is quite different from global attitudes toward the Green Revolution.

In a broad sense, China's attitude towards the Green Revolution is directly related to its historical background. In the course of China's socialist construction, a large number of scientific research activities for the benefit of the people arose, organised either by the government or by the masses on their own initiative, in particular efforts to help the countryside improve their agricultural production methods and breed good seeds. The technologies produced as a result of this scientific research, such as new varieties of seeds, were often promoted in suitable areas at low prices and did not merely remain in the hands of a few. Other essential parts of the Green Revolution, such as water resources and fertilisers, were also the common property of the people, as in the case of the people's communes, which built many collective water facilities that are still functioning decades later.

But no matter how special the historical context of the Green Revolution in China is, it does not change the basic fact that the Green Revolution itself was not 'green', but part of industrial civilisation. Chinese President Xi Jinping has argued that China needs to transition from an industrial civilisation to an ecological civilisation. What is the distinction between the two? In essence, in terms of production relations, the main and defining feature of industrial civilisation is not industry but rather the highly unbalanced and disharmonious relationship between human beings and nature. Since the emergence of class society, there has always been a contradiction between urban and rural areas, and over the past two to three centuries, this disharmony has reached unprecedented heights and is unsustainable. Therefore, President Xi Jinping stressed that, in the context of such profound contradictions, it is necessary to build an ecological civilisation. This concept is characterised by the need to repair the contradictory relationship between human beings and nature; whether there is industry or not is not the key, but to what extent the highly tense relationship between human beings and nature, and between human beings and the environment, which has developed over the past few centuries, has been resolved.

Over the past two decades, a number of Marxist scholars concerned with ecological issues, such as US scholar John Bellamy Foster, have uncovered important theoretical tools such as the 'metabolic rift' to help us understand the important ecological issues that have arisen in the age of capitalism. Since the turn of the twenty-first century, some Chinese universities have been using US economics textbooks to educate their students. Some of these textbooks have impressed the authors of this article, such as those that praise the greatness of capitalism and the market economy, roughly speaking, in the following manner: 'Imagine you live in a city in the United States, and when you get up in the morning, you can drink coffee made in Africa, eat fruit made in Latin America, and wear clothes made in East Asia'. These kinds of imagery and narratives of prosperity have undoubtedly fuelled blind faith in capitalism and the globalised economy. From an ecological point of view, this prosperity of the market economy, in fact, contains the seeds of disorder and destruction. A highly developed market economy involves a high volume of long-distance trade, where African coffee and Latin American fruit, containing the labour of local people and the fertility of the land, are shipped to New York and Europe to become consumer goods. After the nutrients are absorbed in the cities of developed market economies, the leftovers end up as rubbish. However, in traditional agricultural societies, such human and food waste are not rubbish but rather a valuable source of soil nutrients. In the absence of long-distance trade and the frequent interregional movement of materials, these nutrients would flow back to where they came from and be recycled. But in contemporary times, especially in the last two centuries of highly developed globalisation and marketisation, a great contradiction has arisen, namely, that the fertility of the land is being transported from its place of origin to other regions in the form of products, and that the nutrients produced

never have the means to return, which in turn leads to a diminishing of fertility at the place of production and, in the long run, is unsustainable and destructive.

The phenomenon of the fertility of the countryside becoming concentrated in the city and then becoming waste is the material basis of the contemporary urban-rural conflict. Over the past two centuries, during which capitalism gradually became dominant, there have been two waves of the Green Revolution in the world. The first took place in the nineteenth century, before the concept of 'green revolution' had emerged and before the development of the modern chemical industry. At this time, the way to increase soil fertility was to mine bird droppings, or guano, from the small islands scattered in the Americas. To mine guano, many Chinese labourers were transported to the region to work as 'coolies'. The foundation of the agricultural revolution in Europe and the Americas at that time included these poorly paid Chinese labourers and the non-renewable guano fertiliser. The second wave came about with the rise of the chemical industry in the twentieth century, when compound fertilisers were widely used in agriculture through different ratios of nitrogen, phosphorus, and potassium, and fertiliser-sensitive crop varieties were bred to sustain agricultural production.

It can be observed that regardless of which Green Revolution we consider, the underlying logic has always been to maintain or even expand the metabolic rift. This has been achieved by continually injecting fertility from external sources, fundamentally based on the super-exploitation of labour and the unsustainable depletion and pollution of the environment. Logic dictates that this will not solve or even alleviate ecological problems whatsoever, and indeed, it has not in practice. The Green Revolution came with huge ecological costs. For example, since Green Revolution agriculture relied on only a few high-yielding varieties of each crop, the original, diverse varietal system of Indian crops gradually disappeared. Land degradation was also one of the major negative consequences of the Green Revolution. Excessive use of chemical fertilisers has altered the soil microbial community and increased soil salinity, leading to physical and chemical degradation of the soil.[3]

China's Green Revolution, despite its early widespread benefits and relatively low overall chemical usage, still saw rural collectives exploring some ecological conservation efforts, which limited environmental damage during the commune period. However, after China dissolved the communes and entered a market economy, countless small-scale farmers, driven by market forces, rapidly increased their use of chemicals, and the negative impacts of China's Green Revolution gradually became apparent. Around 1970, every kilogram of grain output in China corresponded to only 20 grams of fertiliser input on average; by 2010, every kilogram of grain output corresponded to 110 grams of fertiliser input.[4] In just a few decades, China has become the world's largest consumer of fertiliser. Today, China uses more than 30% of global fertiliser and pesticides annually on less than 9% of the world's arable land.[5] The overuse of fertilisers and pesticides has caused agriculture to surpass industry as China's number one source of surface pollution. Can we continue on this path of heavy reliance on chemical fertilisers and pesticides? Such a situation is clearly unsustainable.

One might counter with the following question: does rejecting the Green Revolution mean that we should all go hungry? Taking India as an example, it is true that India's food production has increased if we look only at the production in a certain number of years after the Green Revolution; but before the Green Revolution, India's total food production was already increasing relatively steadily, and the Green Revolution has not accelerated this trend.[6] From 1950 to 1965, India's wheat production increased by 4% per annum, and for

about 20 years after the introduction of the Green Revolution (1968–1984), wheat production increased by about 5.6% per annum, which is the major evidence that is usually cited to affirm the Green Revolution in India. However, wheat is not a staple food in India, and its status is far less than that of rice. Whereas rice production increased by 3.5% per year prior to the Green Revolution, this fell to less than 2% in the two decades after the Green Revolution. Thus, if one looks at India's entire food supply, production increased by 2.8% per annum for a dozen years before the Green Revolution but fell to 1.9% per annum during its implementation, only to return to 2.5% per annum a number of years after the Green Revolution. Looking at longer-term food data, the Green Revolution did not have a significant impact in terms of solving India's food problems.[7]

Looking at the global food issue, we can observe that over the past 40 years or so, per capita grain production worldwide has basically remained stagnant. This indicator surpassed 370 kilograms in the early 1980s, but it has hovered at a low level for decades since, often not even reaching the levels of the 1980s. Although there has been a slight increase over the past decade, it still hasn't exceeded 390 kilograms.[8] These past few decades have been an era in which the Green Revolution and industrial agriculture have dominated worldwide, yet humanity's ability to feed itself has not seen any substantial improvement.

In other words, even if we forget about ecological issues for a while, the potential of the Green Revolution to increase food production overall has been exhausted, and the mere maintenance of the situation requires continued reliance on high-intensity fossil fuel inputs. But for a large country like China, this possibility does not exist. On the one hand, China has decided to achieve significant carbon reductions, and the industrialised food system is involved in a large amount of carbon emissions, with the latest research suggesting, for example, that the food system accounted for up to a third of total carbon emissions in 2018.[9] If emissions reductions are to be made in food production and processing, fossil fuel consumption in the agricultural sector will have to be reduced. On the other hand, China's decision to reduce emissions comes against the backdrop of global climate change, which is bringing about an increase in average temperatures, a decrease in glacial snow water, and an increase in extreme weather, which will undoubtedly have a considerable impact on agricultural production. Under unfavourable conditions, China's yields of crops such as wheat, rice, and maize could even decline by 20-30% by 2050.[10] Against this backdrop, the 'de-risking' of food security should be given top priority. Green Revolution-style agriculture lacks the resilience to withstand risks due to the prevalence of monoculture crops and high dependence on external conditions, making it difficult to rely on for food security.

The history of socialist construction in North Korea provides us with another important lesson. The socialist construction of North Korea has made great achievements, but the country's agriculture is essentially based on fossil fuels and the Green Revolution. As early as the Kim Il Sung era, North Korea proposed the electrification of agriculture, and its agricultural development once achieved very good results, far exceeding that of South Korea, but this relied on oil imports and intensive use of fertilisers. From 1961 to 1991, its fertiliser inputs and cereal outputs were on an overall upward trend, however, in the early 1990s, due to the impact of geopolitical changes, North Korea's inputs of fertilisers dropped by 90%, which led to a significant drop in grain output, and then triggered what is known as the Green Revolution in North Korea. This led to a period of food hardship, which North Korea called the 'March of Misery'.[11] At that time, North Korea's heavy industry was already one of the best in Northeast Asia, but the country paid a high price for its complete dependence on industrial agriculture based on oil imports.

Indeed, the examples of China and North Korea have provided important lessons for Third World countries. From an environmental and ecological point of view, the Third World cannot rely on industrialisation and fossil fuels to solve its agricultural problems, nor is fossil fuel a reliable option from a geopolitical and risk-reduction point of view. If the Third World wants to truly solve its food security problems without developing a dependence on the so-called 'rules-based international order' of the United States, it must undergo an ecological transformation as soon as possible.

Of course, for a country like China, which is already dependent on industrialised agriculture, would an ecological transition not lead to a loss of production and thus threaten food security? The ecological transition is certainly not costless. But if China can face up to the limitations of the Green Revolution and truly begin to explore the transition to an ecological civilisation, it can make full use of its own strengths to minimise the impact of the ecological transition on food security.

An important condition that China possesses is the existence of extensive grassroots party organisations. These organisations are held in high esteem by the people, and are guided by the line of pursuing socialism and building an ecological civilisation. In the past few years, there have been several important and successful explorations of primary-level party organisations leading cooperatives, which have ensured food security and maintained ecological balance. In the cases we have studied, whether rice and shrimp farming in the lake areas of the Jianghuai Plain or animal husbandry in the Qinghai-Tibet Plateau region, the economic power of the collectives and the political leadership of the party have made it possible to ensure ecological sustainability by making agriculture people-centred rather than profit-centred, and by taking both ecology and production into account from a political standpoint.

Taking the Wuhu region as an example, in March 2022, Wuhu Prefecture's Wanzhi District set up a party organisation-led specialised cooperative to promote the development of the regenerative rice industry, which provides a whole industrial chain of services for 33,000 mu (2200 hectares) of regenerative rice growers in the district, and ensures that the total output of the first season and the second crop stabilises at more than 900 kilograms.[12] Regenerative rice uses rice stubble to re-grow seedlings and spikes with no pesticides and only a small amount of fertiliser, to ensure food production and achieve ecological benefits.

The leading industry established by the party organisation-led cooperative in Dongba Village, Liulang Town, Wanzhi District, is 'rice-shrimp co-culture', a composite farming model that integrates rice cultivation with crayfish farming. As of August 2023, the Dongba Village Cooperative had attracted 171 members. In August 2022, through land transfers, the cooperative consolidated land from two villager groups for contiguous farming. After the land was consolidated and improved together, the cooperative divided 260 mu (17.3 hectares) of land into 11 plots of varying sizes, the largest over 60 mu (4 hectares) and the smallest over 10 mu (0.67 hectares). While cultivating high-quality rice, they dug ring-shaped ditches around the plots for crayfish farming, implementing standardised transplanting, management, and farming practices. By directly returning rice straw to the fields as rich feed for the next season's crayfish, this low nitrogen fertiliser input still yielded high productivity. This method not only addressed the issue of straw utilisation but also achieved increased yields, reduced costs, promoted green farming practices, and improved land use efficiency.

During the field survey, flocks of egrets were seen foraging in the rice fields. Village officials noted that these birds had rarely been seen in the area before. However, since the introduction of the rice-shrimp co-culture, the use of pesticides and fertilisers in the rice fields has been reduced by at least three-quarters due to the high

water quality requirements for crayfish farming. Technicians regularly cultivate beneficial algae and bacteria, further improving the water quality in the rice-shrimp base. In just one year, the farmland's ecosystem has significantly recovered, which is why the egrets, known for their high standards in habitat selection, have been attracted to the area.

Why develop the rice-shrimp industry through party organisation-led cooperatives? The party secretary of Liulang Town offered the following explanation:

> The role of party organisation-led cooperatives goes beyond just developing and expanding the collective economy and helping the people prosper. The more important aspect is the social benefits. If large-scale farmers were to manage it, they would focus on crayfish because it's more profitable, neglecting the rice since it isn't as valuable, which would jeopardise food security. By having party organisations lead cooperatives, we ensure food security, not just in terms of yield per acre but also in terms of ecological sustainability. While we do pursue profits, we don't prioritise them excessively. The rice yield is guaranteed to be at least 500 kilograms per mu.

As a result, the collective not only strengthens farmland protection and safeguards the bottom line of food security, it also creates a green, eco-friendly agricultural model, continuously improving the rural environment and restoring biodiversity.

In the pastoral regions of the Qinghai-Tibet Plateau, we also found examples of collective organisations pursuing ecologically protective production, aiming for social optimisation and ecological sustainability. Gacuo Township, located in the northern part of Shuanghu County, Nagqu City, Tibet, covers an area of 27,400 square kilometres, with an average altitude of 4,900 metres. Once known as an uninhabitable zone, Gacuo Township currently has 125 households and 570 people, spread across two administrative villages. By the end of 2017, the township had a total of 34,456 livestock, including yaks, sheep, and goats. The herders collectively own pastures, livestock, tents, and other production materials as a village unit, with the village collective coordinating the division of labour and planning. At the end of each year, members receive cash incomes as well as distributions of beef, mutton, and dairy products based on the work points they have earned from the collective.

Shuanghu County faces natural disasters almost every year. Eight or nine months of the year are a dry season with withered grass, making its ecosystem extremely fragile. During our field research, we found that, besides achieving significant results in production, distribution, public supervision, and collective cultural development, Gacuo has also made notable contributions to ecological protection, particularly in preserving the snowfields and glaciers (which are also regarded as valuable natural resources).[13] Gacuo Township not only integrates ecological practices into collective production but also diligently protects the surrounding environment.[14] In their herding practices, the herders maintain traditional methods of handling livestock, avoiding the use of vaccines or veterinary drugs unless absolutely necessary. Moreover, they do not leave any waste on the grazing land, but instead regularly transport it back to the township for centralised disposal. Gacuo Township is located in the heart of the Qiangtang National Nature Reserve and extends north into the Hoh Xil National Nature Reserve. According to tests conducted by national authorities, Gacuo's pasture resources could support the grazing of 210,000 sheep units, yet the total number of livestock in Gacuo is kept

below 50,000 sheep units, with a strict rotational grazing schedule enforced to protect the grasslands. Even during seasonal migrations, locals use yaks instead of tractors, saying, 'tractors are good, but they create tracks that, over time, damage the grasslands'.

With the implementation of the dual responsibility system for livestock and grassland contracting in the late 1980s, China's pastoral areas have faced severe challenges of overgrazing. Issues such as grassland degradation and soil desertification have, in turn, become significant obstacles to the continuous income growth of herders.[15] To address these issues, the government implemented the Grassland Ecological Protection Subsidy and Incentive Mechanism in 2011, encouraging herders to reduce livestock numbers and restore degraded grasslands. However, the actual impact has been limited, with some areas seeing an increase in livestock rather than a reduction, leading to continued grassland degradation.[16] So, how does Gacuo Township strictly maintain the sustainability of its grasslands and surrounding ecosystems? First, the collective manages grazing and resting periods according to the characteristics of winter and summer pastures, with grassland planning being the most critical task. A major planning session is conducted every three years, and at the end of each year, there is a patrol and assessment of the grasslands. If any degradation is found, the area is designated for resting or prohibited from being grazed the following year while also reserving grasslands for disaster prevention during the winter and spring. Second, there are clear limits on how many livestock each pasture can support and for how long, with no overloading allowed under any circumstances.

Additionally, if a production team needs to migrate, for example, from Pasture A to Pasture B, there are strict regulations on how long the migration should take. If they need to stop at Pasture C due to special circumstances like weather, and the stay exceeds two days, they must report and apply to the village to use the pasture to prevent overloading Pasture C. In special cases, such as when a snow disaster hits one village's pasture, production teams can apply to use a nearby pasture from another village for emergency relief. This kind of adjustment is only possible through a collective economic organisation, which effectively maintains the sustainability of pastoral production.

Over the years, Gacuo Township has led Shuanghu County in economic development. Due to the collective division of labour and supervision mechanisms, the quality of livestock products like beef and mutton produced here is superior to that of surrounding townships, commanding the highest prices – a concrete manifestation of the strength of the collective economy. Notably, Gacuo's development has not been driven by external trade but has focused on meeting internal demand. In the face of harsh climate and fragile ecological conditions, they chose to use collective strength to protect and manage public resources and safeguard the surrounding environment. This proves that only a collective economy can maintain a balance between community life, economic development, and environmental sustainability.

The discussion above highlights the importance of grassroots party organisations in China. We understand that many Third World countries lack such formal organisational structures, but they do possess a variety of widespread mass political organisations, both formal and informal local community organisations, and a significant number of socialist forces, all of which can play a substantial role. Fundamentally, Third World governments and the masses can generally benefit from an ecological path, so the political foundation for an ecological shift objectively exists, and the specific forms of practice can certainly flourish in diverse ways.

In recent years, China's ecological civilisation has made significant progress in theory, policy, and local practice. However, looking to the future, the task remains daunting, and determining how to advance towards

an ecological civilisation is an issue that we must address both now and in the future. Of course, this is not just China's task but a challenge for all humanity. There is much that China and the world can learn from each other. China's practitioners and researchers need to better understand practices and theories from around the world that go beyond industrialised agriculture, while people in many other countries can find inspiration and encouragement in the achievements and prospects of China's collective economy and ecological agriculture.

Notes

[1] An earlier version of this article was published in the Chinese edition of *Wenhua Zongheng*. Ding Ling and Xu Zhun, '中国农业为什么必须生态转型' [Why Chinese Agriculture Must Undergo an Ecological Transformation], 文化纵横 [Wenhua Zongheng], no. 3 (2024): 96–106.

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[3] R. B. Singh, 'Environmental Consequences of Agricultural Development: A Case Study from the Green Revolution State of Haryana, India', *Agriculture, Ecosystems and Environment* 82, no. 1–3 (2000): 97–103.

[4] Xu Zhun, 'Farm Size, Capitalism, and Overuse of Agricultural Chemicals in China', *Capitalism Nature Socialism* 31, no. 3 (2020): 59–74.

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[6] Glenn Davis Stone, 'Commentary: New Histories of the Indian Green Revolution', *The Geographical Journal* 185, no. 2 (2019): 243–250.

[7] See above for data here.

[8] Data based on the Food and Agriculture Organisation (FAO) of the United Nations.

[9] Francesco N. Tubiello, Cynthia Rosenzweig, Giulia Conchedda, Kevin Karl, Johannes Gütschow, Pan Xueyao, Griffiths Obli-Laryea, et al., 'Greenhouse Gas Emissions from Food Systems: Building the Evidence Base', *Environmental Research Letters* 16, no. 6 (2021): 065007.

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[11] Xu Zhun, 'Industrial Agriculture: Lessons from North Korea', *Monthly Review* 75, no. 10 (2024): 30–47.

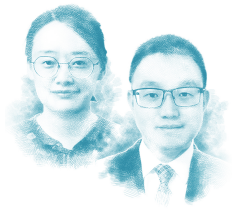
[12] Hu Xiaodong, '湾沚区农业农村局积极种植再生稻 增产又高效' [Wanzhi District Agriculture and Rural Affairs Bureau Actively Plants Regenerated Rice to Increase Production and Efficiency], Wanzhi District People's Government, Wuhu Prefecture, 1 April 2022, **https://www.wanzhi.gov.cn/xwzx/gzdt/12065463.html**.

[13] Researchers: Ding Ling, Qi Lixia, Yan Hairong (July 2018).

[14] Ding Ling, Qi Lixia, and Yan Hairong, '藏北高原上的牧业集体社区——那曲嘎措乡的乡村振兴之路' [Pastoral Collective Community on the Northern Tibetan Plateau: The Road to Rural Revitalisation in Gacuo Township of Nagchu], 经济导刊 [Economic Herald] 10, 2018.

[15] Yang Siyuan and Song Zhijiao, '玛曲高寒草原畜牧业的可持续性考察' [An Examination of the Sustainability of Livestock Husbandry in the Maqu Alpine Grassland], *政治经济学报* [Journal of Political Economy] 5, (2015).

[16] Fan Mingming and Zhang Qian, '生态补偿给谁？——基于尺度问题反思草原生态保护补助奖励政策' [Ecological Compensation to Whom?: Rethinking the Grassland Ecological Protection Subsidy Incentive Policy Based on the Scale Problem], *学海* [Xuehai] 4, (2018).



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