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Industrial development and benefit sharing of mountain agriculture: The Tartary buckwheat (*Fagopyrum tataricum* Gaertn.) industry in Southwest China

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Abstract

In the context of corporate-led agricultural industrialization, the agricultural systems in the mountainous areas of Southwest China are undergoing significant transformations, profoundly impacting the local agroecological environment and farmers' livelihoods. This study aims to investigate how the "company + farmer" model influences the cultivation of buckwheat in the Liangshan Yi region in Southwest China. The study hypothesizes that while this model provides market opportunities for farmers, it also marginalizes them from equitably benefiting from industrial growth, leading to the abandonment of traditional crop production and negative impacts on the local agroecological environment and food culture. Drawing on anthropological fieldwork, this study gathers qualitative data from participant observation and interviews to analyze the socioeconomic and ecological implications of these changes. The findings revealed that the push for agricultural industrialization has resulted in the replacement of traditional food crops, including buckwheat, with cash crops, fostering a monoculture system that undermines biodiversity and local food security. The study concludes that future rural development efforts must prioritize the cultural and ecological roles of traditional farming communities and promote a farmer-centered, diversified agricultural production system.

Keywords: Mountainous agriculture landscapes; Agricultural industrialization; Food culture; Food security

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1. Introduction

In the era of globalization and market-oriented reform, Chinese agriculture is undergoing a profound transformation. The transfer of land use rights has led to the rapid emergence of new agricultural business entities, including agricultural leading enterprises, large-scale professional farming households, farmers' cooperatives, and family farms. These changes are reshaping the traditional smallholder-dominated agricultural landscape. At the same time, the growing commercialization and industrialization of agriculture are altering cropping patterns in many rural areas, with cash crops gradually replacing traditional food crops. As a result, the agricultural production system in the mountainous highland of Southwest China is undergoing fundamental changes, which

have far-reaching implications for both the local ecological environment and farmers' livelihoods.

The "company + farmer" model has emerged as the dominant production system driving agricultural industrialization in China. According to statistics from China's Ministry of Agriculture and Rural Development (MARD), by the end of 2020, more than 90,000 leading enterprises had been recognized by authorities responsible for agricultural industrialization at the county level or above.[1]

Policymakers argue that supporting these "dragon-headed" enterprises can provide capital, technology, and market access, effectively integrating decentralized agricultural production with processing and marketing. This integration is expected to increase farmers' incomes and boost the agricultural economy.

Scholars have varying perspectives on the corporate-led industrialization model. Proponents of mainstream economics argue that it promotes agricultural modernization, fostering a mutually beneficial relationship between enterprises and farmers.[1] Conversely, political economists critique this model, viewing it as the articulation of capitalist and non-capitalist production. They argue that while capitalist production secures the labor and raw materials necessary for accumulation, family farming faces structural constraints that lead to stagnation.[2,3] Other scholars highlight that corporate-led industrial development projects often result in land grabbing, the erosion of traditional values, and growing internal divisions within local communities, ultimately undermining farmers' livelihoods.[4-8]

Despite these critiques, there is limited literature evaluating the impacts of corporate-led agricultural development projects from the perspectives of biodiversity and sustainable agricultural development. This study aims to fill this gap by examining the transformation of buckwheat cultivation in the Liangshan Yi region, focusing on the socioeconomic and ecological implications of corporate-led agricultural industrialization.

The study focuses on buckwheat, a traditional crop with significant cultural, ecological, and nutritional value for the Yi people in Southwest China. Buckwheat is deeply embedded in the cultural practices and dietary traditions of the Yi community, serving not only as a staple food but also as a symbol of their agricultural heritage.[9] Ecologically, buckwheat is a resilient herbaceous plant in the Polygonaceae family, with two cultivated species: Common buckwheat (*Fagopyrum esculentum* Moench.) and Tartary buckwheat (*Fagopyrum tataricum* Gaertn.). Research has reported that Southwest China is the original region for cultivated buckwheat.[10,11] After thousands of years of cultivation and spread, buckwheat is now widely cultivated globally.[12,13] While common buckwheat is cultivated worldwide, Tartary buckwheat is concentrated in the Himalayan region, particularly in Southwest China.[14,15]

Buckwheat is a crop with a relatively short growing season that thrives in a variety of environmental conditions. Studies indicate that growing buckwheat can improve soil health and quality,[16,17] making it an ideal choice for organic and agroecological farming. Beyond its environmental benefits, this crop has attracted considerable interest from researchers due to its rich nutritional and medicinal value.[18-21]

Although buckwheat cultivation has a long history in China and remains an important staple crop for farmers in the mountainous regions of Southwest China, it has not received sufficient attention due to its low yield. However, increasing commercialization in China's rural areas has highlighted the value of buckwheat as a functional food ingredient, attracting significant investments from food companies in China over the past decade. Along with this trend, consumer demand for buckwheat-based products, such as noodles, flour, tea, wine, and other health products, has also been increasing.[22]

Despite growing demand for healthy foods, buckwheat production is facing increasing challenges. Researchers indicate that buckwheat cultivation is declining in the Yunnan Province due to reduced land, labor shortages, and changes in the living environment and dietary habits.[23] However, existing studies have mainly focused on sociocultural and policy factors.

This study seeks to address the following research questions:

(i) How does the corporate-led "company + farmer" model influence the cultivation of traditional crops, particularly buckwheat, in the Liangshan Yi region?
(ii) What are the socioeconomic and ecological implications of these changes for local farmers and the agroecosystem?
(iii) How can future rural development efforts balance agricultural industrialization with the preservation of traditional farming practices and biodiversity?

The research hypothesizes that while the "company + farmer" model provides market opportunities, it also marginalizes local farmers from equitably benefiting

[1] For details, please refer to: "Report on the Implementation of the National Economic and Social Development Plan for 2023 and the Draft National Economic and Social Development Plan for 2024," Xinhua. 2024-03-13. https://www.gov.cn/yaowen/liebiao/202403/content_6939276.htm

from industrial growth, leading to the abandonment of traditional crop production and negative impacts on local agroecosystems and food culture. By analyzing the transformation of buckwheat production methods, this study aims to provide insights into the broader impacts of corporate-led agricultural industrialization on traditional farming systems, biodiversity, and rural livelihoods.

2. Methods

This study employed a qualitative research approach. Data were collected through anthropological fieldwork conducted between 2010 and 2016, including participant observation and semi-structured interviews with farmers, enterprises, traders, and government agencies in Xichang, Zhaojue, Butao, Meigu, and Yanyuan in Sichuan Province, as well as Kunming and Ninglang in Yunnan Province. To gather the most up-to-date information, tracking surveys were conducted in the region over the past 2 years, 2023-2024. These surveys involved WeChat exchanges with previous respondents, follow-up phone calls, and the collection of publicly available data from online media.

3. Results and discussion

3.1. Traditional mountain agricultural systems in the Liangshan Yi region

The Greater Liangshan Yi Autonomous Prefecture (*Da Liangshan Yizu Zizhi Zhou*) and the Lesser Liangshan Yi Autonomous Prefecture (*Xiao Liangshan Yizu Zizhi Zhou*) are the main settlements of the Liangshan Yi people (autonym: *Nuosu*). These regions straddle the border between southern Sichuan and northern Yunnan, forming a transition zone between the Qinghai-Tibetan Plateau and Yunnan-Guizhou Plateau. Characterized by a mountain landscape of high hilly plateaus, they are located in a biodiversity hotspot[24,25] and are considered the earliest domestication areas of Tartary buckwheat.[26] Most *Nuosu* communities are found between 2,000 to 3,000 m above sea level, and their traditional livelihoods rely on a combination of dryland farming and livestock husbandry.

Our visit to the Lesser Liangshan Yi Autonomous Prefecture in the winter of 2011 revealed a landscape of high mountains and deep ravines, with solitary villages nestled among thick forests. On the slopes near the villages were banks of loess fields cleared by hand. In early spring, these fields would be planted with the region's staple grain crop, Tartary buckwheat (*F. tataricum* Gaertn.). Locals call buckwheat "*qiaozi*" in Chinese and "*mgep*" in their own Yi language. Resilient to cold, drought, and poor soils, buckwheat is one of the few grain crops capable of adapting to the region's alpine mountain environment. Alongside potatoes and maize introduced during the Qing dynasty, buckwheat remains one of the three major crops of the Liangshan Yi region today.[27] In high mountainous areas, buckwheat is rotated with potatoes and barley, while on the middle slopes, it is rotated with potatoes and maize.[21] In 1943, Lin Yaohua led a research team into the Liangshan hinterland and documented the local buckwheat production method known as "fire-fallow" in his book.[28;58] This mode of farming involved burning mountain areas to fertilize the land and sowing crops without a structured plan. It was later reformed by the government.

Before the democratic reforms of 1956, the Liangshan Yi society was primarily ruled by separate polities of the Black Yi clans. These clans maintained a strict caste order based on bloodline using clan organizations and customary laws[2]. Clans are considered to be groups with ties of kinship in the paternal line based on a belief in a common ancestor. Agricultural production was mainly carried out on a family-run basis. After the democratic reforms, agricultural production was instead organized and managed by rural collective bodies, such as the production brigades and people's communes.

According to the recollections of some elders, during the collective economy period from the 1960s to1970s, a 2-year cropping system with three harvests was practiced in the area. Spring crops were potatoes and buckwheat; winter crops were wheat and oats. After harvesting wheat in May of the 2nd year, farmers would plant a summer crop of broad beans since it was too late to plant spring crops. Compared to one-season cropping, this three-harvest, 2-year system not only increased annual farming income but also reduced losses from natural hazards through diversification. In addition, this cropping system regulated soil nutrients and contributed to biodiversity conservation.

In the 1980s, as part of market-oriented reforms, the collective economy of China's rural areas was dismantled. Instead, the family contract responsibility system for rural land was introduced, and the land was redistributed to individual peasant families. Consequently, China's agricultural production shifted to a decentralized smallholder model.

In 2013, fieldwork was conducted in Zhipu village, located in the Liangshan Yi region. This village is situated on flat land among the mountains at an altitude of over 2,600 m. The village has a total area of farmland of 4,016 *mu* (268 ha) and a population of 706 people in 213

[2] There were five castes: *zimo*, *nuohe*, *qunuo*, *ajia* and *xiaxi*. The *zimo* was the caste of headmen who dealt with the central Chinese government, known as *tusi* in Chinese. The *nuohe* were the Black Yi. The other three castes were all linked to the *zimo* and Black Yi in terms of personal bondage.[29;65-72]

households. After the distribution of land use rights to rural households, the original 2-year, three-harvest farming system in Lamo village could no longer be sustained, and wheat farming was gradually abandoned. This was due to the inability to address the irrigation issues that arose with the land division, as wheat requires irrigation. Some families' land was located far from the irrigation canals, making it impossible for them to irrigate, leading to the abandonment of wheat cultivation. Even those living near the canals might give up growing wheat because households upstream no longer cultivated wheat and, as a result, did not release water for irrigation. Consequently, the canals were no longer repaired and quickly became clogged and damaged. In reality, individual household farming, which was limited in terms of capital, labor, technology, and land, led to a reduction in the variety of crops grown, and even making animal husbandry impossible.

At present, the main local crops in Zhipu village are potatoes and buckwheat planted in rotation. Due to the relatively high altitude, maize yields are low; thus, only a small amount is planted. Other crops include oats, turnips, green manure plants, and a limited selection of beans and vegetables. There was only one season for planting the main food crops. Potatoes are planted by the end of March, followed by buckwheat in April. Farmers grow various buckwheat varieties in different regions, drawing on their experience and traditional knowledge to adapt to the soil conditions at different altitudes.[9]

On the day of cultivation, the villagers would perform a purification ceremony of their plowing tools and seeds early in the morning (*erchasu*),[9] hoping for a good harvest and to protect the crops from damage by hailstorms or pests. Their greatest concern is sudden hailstorms that occur just as the buckwheat is nearly ripe, which can knock all the wheat ears to the ground, or strong winds that flatten crops. *Erchasu* is a traditional ceremony of purification across the Liangshan Yi region. On that day, nine stones are placed in a fire until they glow red hot. Special plants are then placed on the stones, and the seeds and agricultural implements are passed through the smoke. This ritual is believed to dispel anything unclean and ensure a good harvest.

Throughout the cultivation period, villagers assist each other with their relatives and collaterals. Single-family plowing is inefficient, making it difficult to handle the rush of work during harvest and planting seasons. Working alone as a family makes it difficult to complete the intensive tasks required at these times. Typically, men lead the plow, guiding it and encouraging the ox, while women follow behind, planting seeds into the furrow and applying phosphate and homemade fertilizers. As the plow begins to cut the second furrow, the turned soil covers the seeds in the first furrow. In recent years, some families have begun to use small tilling machines that are slightly more efficient. After the dissolution of rural collective economic organizations, this family-based agricultural production—where labor is divided among family members and small-scale cooperation occurs within the community—has become the primary form of local agricultural production.

In traditional agricultural systems, local social organization and cultural practices—such as production management knowledge, cooperation among community members, cultural customs, religious rituals, and food habits—are essential for sustaining agricultural production and ecological development. For example, based on the local classification of buckwheat and religious taboos, people use different varieties of buckwheat for different ceremonial occasions,[21] which has contributed positively to the conservation of buckwheat diversity.

Consequently, the cultivation of buckwheat, a traditional crop, plays an important role in strengthening community cooperation and solidarity. Buckwheat has been both a vital food source for the Liangshan Yi region and a ritual significance in the Yi society (rich in cultural associations and an important cultural status). During the study, local scholar Dr. Jiarimuji mentioned that buckwheat was intrinsically embedded in the lives of the Yi people, supporting them materially and spiritually in every stage of life, from birth to death. Hence, researching buckwheat can serve as an entry point to understanding the development of the political economy, society, and culture of Yi society. Buckwheat is used for a variety of religious ceremonies and social occasions, granting it a transmittable soul and high status. Its cultural status is reflected in the local proverb: "Many people, the mother of man is great; crop varieties, crop buckwheat is great." In the local society, buckwheat symbolizes honor, security, fertility, and abundance. Whether it is an important event in an individual's life cycle or a major social event, buckwheat plays an integral role, including childbirth, the naming of newborns, the dress-changing ceremonies for girls (mitzvahs), weddings, funerals, ancestor worship, farming, hunting, traveling, festivals, hospitality, and making vows.[21] This significance is also reflected in the local saying: "Buckwheat for ancestor worship, buckwheat for hospitality."

In summary, production rooted in community cooperation and diversification is vital for sustaining agricultural production and supporting farmers' livelihoods. However, over the past decade, the farming system in the southwestern mountains has undergone significant transformation due to land transfers and the industrialization of agriculture.

3.2. Industrialization of mountain agricultural resources and the social and environmental impacts

Since the 21st century, buckwheat products have entered urban markets, with their high nutritional value and health benefits favored by green food consumers. The growth of the buckwheat industry became even more apparent after 2008. Within a few years, a large number of buckwheat specialty stores, specializing in the sale of buckwheat tea, appeared in cities across Southwest China, such as Xichang, Chengdu, and Kunming, and the market rapidly expanded to supermarkets in major cities across the nation. The health benefits of buckwheat tea were promoted online: "high rutin content" and good at reducing the three "highs" (high blood sugar, high blood pressure, and high cholesterol). Emphasis was placed on the environment in which buckwheat is grown: "grown at high altitude in a mountain region" and "a green product with no pollutants." This undoubtedly resonated with the present demand for safe food, leading to high sales of buckwheat tea. The buckwheat industry boomed and became a major local agricultural enterprise. This practice of using the cultural reinvention of local products to promote local economic development is not uncommon throughout the country and has even become a common development model. An example is the crayfish industry in Xuyi, Jiangsu Province, which can be regarded as a classic case where the local government stimulated the growth of lobster consumption by striving to create a lobster culture as a means of boosting the development of the local tourism industry and rural economy.[30]

The local government resolved to promote Liangshan as the "Hometown of Buckwheat." Under the supervision of the County Agricultural Bureau, a Buckwheat Association composed of various enterprises was established to assist enterprises in promoting their products and expanding their markets. This initiative aimed to drive the scaling, standardization, and development of the entire buckwheat industry. Similar to most agricultural development projects nationwide, the tartary buckwheat industry has adopted the "company + farmer" industrialization model. By directing support funds toward leading large enterprises, the government aims to leverage the scale effects and technological advantages of these companies to encourage surrounding farmers to participate in cultivation, ultimately increasing their income.

Tartary buckwheat enterprises rely on high-quality raw materials provided by farmers to develop a diverse range of products, such as Tartary buckwheat wine, tea, and noodles, which have been registered as national geographical indication products. In addition to deep processing of Tartary buckwheat products, these enterprises also make full use of the region's unique ethnic culture and ecological resources to develop ethnic tourism and eco-wellness industries.

In market research conducted in Kunming and Xichang in 2013,[31] a 450-g box of high-grade buckwheat tea cost nearly 1,000 yuan in a specialist buckwheat tea store, while medium- and low-grade teas cost between a hundred and several hundred yuan. During the peak tourist season, some of the stores made monthly profits of more than 100,000 yuan. As competition in the industry intensified, the price of buckwheat products declined accordingly. Despite these changes, the retail price of 450 g of buckwheat tea ranged from tens to several hundred yuan in 2015. The distinction between high- and low-end products is primarily based on packaging quality and rutin content. Black buckwheat, which grows at higher altitudes and yields less, is said to have the highest rutin content. However, unprocessed buckwheat that companies purchase from traders is often a mixture of different varieties; separating these variations is either impractical or too costly, making it impossible to process small quantities of black buckwheat separately. As a result, terms such as "black buckwheat tea" and other similar buckwheat products are often used as marketing strategies by companies to add value. For farmers in most areas, the purchase price of black buckwheat and other varieties remains the same. For companies, buckwheat is a small part of their production costs. The significant price difference between low-cost commodities and expensive "green health products" is generating substantial profits for companies and attracting a growing number of investors to the industry.

In Xichang, Tartary buckwheat tea and the Yi Torch Festival together form the core elements of the original Yi culture, making them a major attraction for local tourism. The Tartary Buckwheat Cultural Park, operated by a food enterprise, attracts a steady stream of visitors every day. The park not only showcases the history of buckwheat cultivation and processing techniques but also incorporates traditional Yi cultural performances, allowing visitors to savor tartary buckwheat delicacies while gaining a deeper understanding of the unique charm of Yi culture. Display cabinets in the cultural park exhibit a variety of local buckwheat seeds, neatly arranged by type. Each variety is labeled with its local Yi name, and some also include scientific name abbreviations and serial numbers. The exhibition strives to convey to visitors that local plant varieties and traditional knowledge are rich and diverse, the natural environment is exceptional, and the enterprise is well-equipped with the intelligence and capabilities to develop and utilize these resources scientifically. As a result, the company operates in an

ethical, responsible, and qualified manner, making it well-suited for scientific development. Hence, consumers can fully trust the company to provide high-quality health products. In this context, native knowledge of plant species, customs, traditions, and religious ceremonies are valued and respected, framed as potential solutions for the crisis of modernity. This approach adds value to buckwheat products, ultimately helping the enterprise above-average profits in the food products market.

However, most Yi farmers find it difficult to benefit from these development projects. The buckwheat industry is disconnected from villagers' lives, even though they supply the raw materials and are the original creators/practitioners of this cultural resource. As the processing and market linkages are controlled by corporations, farmers can only derive labor income from the crop. For example, the yield of bitter buckwheat is extremely low, typically 100 – 150 kg/acre of land, while the market price is 3 – 4 yuan/kg[3]. Cost accounting revealed that this price could not even cover the cultivation costs[4].[31] In addition, farmers have to face natural and market risks. In fact, farm income typically covers only basic food and clothing needs, making it difficult to meet the broader reproductive needs of a modern family, such as education, healthcare, and elder care. As a result, young and middle-aged farmers are forced to seek alternative employment opportunities. Unfortunately, urban migrant workers also often face unfair treatment in the labor market.[32]

The issue of fair distribution within local communities directly affects the sustainable development of the bitter buckwheat industry. As a large number of farmers migrate for work, the shortage of local agricultural labor has become more pronounced, resulting in the abandonment of bitter buckwheat in many villages. This affects the stability of the bitter buckwheat raw material supply and hinders the further expansion of leading bitter buckwheat enterprises. Enterprises complain that the supply of raw materials is tight, forcing them to compete fiercely to purchase unprocessed buckwheat. We can observe this situation in the following news report about the buckwheat tea industry: "Consumers love it; farmers won't plant it; investors build lots of plants; lack of raw material base areas to supply them. Annual production is high but enterprises struggle to buy in."[33] In fact, the question of who will farm has become an urgent issue for China.

Labor shortage and the advancement of agricultural industrialization have also had a profound impact on the local ecological environment. The traditional circular agroecosystem is becoming unsustainable as more farmers are forced to give up animal husbandry due to reduced family labor. Some families are even reducing the amount of land they farm. The decline of animal husbandry has not only diminished sources of agricultural income but also weakened families' ability to manage risks, making it harder to maintain a healthy ecological cycle in farming.

In the past, soil fertility largely depended on homemade fertilizers made from a mixture of fermented sheep and pig manure, buckwheat straw, pine needles, and oak leaves. At present, farmers increasingly rely on chemical fertilizers. For instance, in maca cultivation[5], high costs of seed led farmers to use excessive fertilizers and pesticides to ensure high yields, while neglecting crop rotation and fallow periods. This practice has detrimental effects on the local environment, including loss of agricultural biodiversity, deforestation, soil compaction, and contamination of agricultural plastics.

With the nationwide promotion of genetically modified crops, such as maize and soybeans, agricultural biodiversity is likely to decline even further. In addition, many traditional seeds have been patented by large agribusiness companies through biotechnological interventions, resulting in farmers losing their rights to these seeds.

Commercial cultivation not only impacts the local ecosystem but also threatens the sustainability of local culture and food systems. As traditional crops, such as buckwheat and oats, are increasingly replaced by cash crops, people are gradually adopting a rice-based diet and becoming more reliant on the food market, consequently altering their lifestyles and cultural values. Moreover, the volatility of cash crop prices has led to more speculative cultivation decisions among farmers, increasing the precariousness of their livelihoods and altering their perceptions of wealth accumulation through hard work.

4. Conclusion

In the process of enterprise-led agricultural modernization, the agricultural production system in the mountainous regions of Southwest China has undergone a profound transformation. The traditional pattern of local diversified cultivation is gradually giving way to monoculture structure and non-food cultivation, as farmers shift from subsistence agriculture to commodity agriculture focused on meeting market demand. Recently, with the acceleration

[3] More specifically, according to market research,[31] from 2009 to 2013, the market price of buckwheat ranged from 2.2 to 2.8 yuan/kg. In 2014, it reached a record high of 3.4 – 3.6 yuan/kg, but declined to 2.6 – 2.8 yuan/kg in 2015.

[4] In 2012 – 2017, the local market price for rural labor was 60 – 100 yuan/day. Cultivating an acre of buckwheat requires an investment of about five labor days.

[5] A plant of South American origin that had exploded onto the Chinese market between 2011 and 2016 and became widely grown in the southwestern mountains.

of land transfer and urbanization, the trend of farmers withdrawing from agriculture is expected to continue, profoundly altering the agricultural landscape in these mountainous areas, a change that will be difficult to reverse. This shift is primarily driven by evolving socioeconomic conditions in contemporary China, including changes in production organization, land policies, labor markets, and distribution relations. Ultimately, the cultural and agricultural landscapes reflect the design of the agricultural mode of production.

In the industrialization of buckwheat tea, dragon-headed enterprises have taken center stage in the development, supported by the government. The government aims to leverage these enterprises to facilitate sales of agricultural products, allowing farmers to indirectly participate in the market and increase their income. However, while these companies benefit significantly from low-cost raw materials and the utilization of local cultural resources to achieve substantial profits in the health food market, farmers do not share in these market gains. Instead, they often receive insufficient compensation for their labor in supplying raw materials and must bear production risks on their own. This development model has failed to meet the government's objective of "bringing farmers into development." Enterprises exploit farmers' surplus labor through market exchange, leading to capital accumulation at the farmers' expense and widening the wealth gap. Although government support has alleviated some burdens on farmers through road construction and agricultural subsidies, the intention to bridge the rich-poor divide through this secondary distribution often only reinforces farmers' subordinate status.

Industrialized agriculture in the mountainous regions of Southwest China has also had a significant impact on the sustainability of the local food system, reducing the ability of local farmers to adapt to climate change and market risk, and weakening the ability of communities to self-organize. In the long run, this shift could have serious implications for agrobiodiversity and national food security. Moving forward, many scholars and social organizations should focus on utilizing and restoring the food and cultural diversity of different regions while redesigning sustainable agricultural production systems.

Agricultural heritage systems (e.g., globally important agricultural heritage systems) are considered dynamic and adaptive living systems that embody values of multifunctionality and sustainability.[34] As a result, the traditional agricultural management of indigenous crop varieties has gained increased attention worldwide for its role in sustainable agriculture. China has also made great achievements in the conservation and management of agricultural heritage systems over the past 10 years.[35] At the same time, many scholars and social actors are working to position smallholder farmers as the cornerstone of development by promoting alternative models, such as People's Food Sovereignty, Participatory Breeding, and Nested Markets.[36] However, more scholars and development programs have focused only on market-oriented industrial development and the role of traditional cultural excavation in preserving traditional farming systems, but have seldom addressed the question of who truly benefits from these development programs. This study argues that to ensure more benefits remain with local farmers, it is crucial to organize them into diversified agricultural production and use local resources to develop agro-processing industries within local communities, rather than reducing farmers to mere suppliers of raw materials to the agri-food system. In fact, the practical experience from China's collective farming period can provide valuable insights into this farmer-cooperative approach to development.

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Conflict of interest

The authors declare they have no competing interests.

Author contributions

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Ethics approval and consent to participate

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