

Article

Collaboration to Address the Challenges Faced by Smallholders in Practicing Organic Agriculture: A Case Study of the Organic Sorghum Industry in Zunyi City, China

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Abstract: In many developing countries, organic agriculture is increasingly recognized as a key strategy for promoting rural economic development and improving farmer welfare. It is primarily smallholders who form the foundation of organic production in these areas. However, these farmers face significant challenges in adopting organic farming methods. The aim of this paper is to investigate solutions to the challenges encountered by smallholders. This research utilizes an integrated approach and includes a case study of the organic sorghum sector in Zunyi, China. The findings indicate that (1) a robust partnership has been established between enterprises, government, and farmers in the organic sorghum industry in Zunyi. Enterprises purchase the sorghum, cover organic certification costs, and partially fund material inputs, while local government facilitates organization, coordination, and technical support, with farmers responsible for production. (2) This collaboration has catalyzed high-quality development in the industry, benefiting all stakeholders. (3) Through this collaborative model, common challenges faced by smallholders, such as obstacles in obtaining certification, income fluctuations, and unfair market conditions, have been mitigated. Consequently, smallholders secure stable and reliable income as they benefit from favorable contract prices for organic sorghum and the assumption by enterprises of most material input costs. This study offers valuable empirical evidence that can guide the expansion of organic agriculture in similar regions and countries.

Keywords: organic agriculture; collaboration; smallholder; enterprise; government; sorghum industry



Citation: Wu, S.; Li, S. Collaboration to Address the Challenges Faced by Smallholders in Practicing Organic Agriculture: A Case Study of the Organic Sorghum Industry in Zunyi City, China. *Agriculture* **2024**, *14*, 726. <https://doi.org/10.3390/agriculture14050726>

Academic Editor: Nathalie Iofrida

Received: 15 April 2024

Revised: 29 April 2024

Accepted: 6 May 2024

Published: 7 May 2024



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1. Introduction

Organic agriculture represents an environmentally sustainable method of food production [1,2]. It denotes farming systems that utilize natural resources and minimize or strictly limit external inputs like synthetic fertilizers and pesticides [3]. This approach can advance various objectives of sustainable agriculture, demonstrating various benefits, such as enhancing food safety [4], mitigating soil degradation [5–7], bolstering wild and agrobiodiversity [8], and removing hazardous agrochemicals [9–11]. Nonetheless, the impact on reducing greenhouse gas emissions remains a subject of debate [6,12].

Since the dawn of the 21st century, organic agriculture has experienced rapid growth globally, with China emerging as a leading nation in this field. From 2000 to 2022, the global area of organic farmland surged by over 500%, reaching 96 million hectares, while the organic market expanded nearly eightfold, escalating from EUR 15 billion to approximately EUR 135 billion [13]. In China, the sector has seen significant expansion over the last two decades, with organic farmland increasing from a mere 4000 hectares in 2000 to an estimated 2.9 million hectares by 2022 [13,14]. China ranks fourth in the world in terms of land area for organic agriculture [13]. It also holds the position of the third largest organic

market worldwide. In 2022, the leading countries by organic market size were the United States (EUR 58.6 billion), Germany (EUR 15.3 billion), and China (EUR 12.4 billion) [13].

Globally, a significant portion of organic agriculture is undertaken by smallholder farmers, particularly in numerous developing countries across Asia, Africa, and Latin America. According to the Food and Agriculture Organization's (FAO) classification, farming entities managing less than 2 hectares of land are categorized as small farmers [15]. As of 2022, organic farming spans nearly 190 countries, engaging approximately 4.5 million farmers [13]. While precise data on the proportion of these farmers who are smallholder farmers are lacking, it is reasonable to infer that this number is substantial, given that the vast majority of family farms worldwide are of a small scale. Research indicates that there are around 608 million family farms globally, with approximately 70% occupying less than 1 hectare and 14% spanning 1 to 2 hectares [16]. Numerous research institutions and academics assert that organic agriculture can significantly enhance the livelihoods of smallholder farmers by improving soil fertility, reducing input costs, boosting profits and incomes, and minimizing exposure to toxic chemicals [6,10,17,18].

Nevertheless, smallholder farmers encounter numerous challenges when participating in organic farming. The existing research literature indicates that smallholder farmers commonly encounter the following challenges in practicing organic agriculture. (1) The first challenge involves the difficulties associated with acquiring organic certification. Smallholder farmers encounter obstacles in the form of high certification fees and cumbersome procedures, which impede their transition to organic agriculture [19–22]. Particularly for resource-poor and marginal smallholder farmers, the financial burden of organic certification is exceedingly challenging [23,24]. (2) The second challenge pertains to income instability. Firstly, the inadequate or fluctuating premium for organic products directly impacts the income of smallholder farmers [25,26]. Secondly, the sales market proves unstable or challenging to expand, making it difficult to sell organic agricultural products [20,27,28]. Lastly, smallholder farmers face relatively high costs for seeds, organic fertilizers, transportation, and other expenses in the organic production process [29,30], which hinder their ability to attain significant incomes. (3) The third challenge concerns the limited degree of organization among farmers. Many studies have emphasized that the organizational capacity of farmers is key to promoting the organic market participation of smallholder farmers [31–33]. The weak organizational capacity of villages is an important factor that prevents smallholders from entering the organic farming market [32,34]. Furthermore, the lack of industry associations and non-governmental organizations (NGOs) makes it arduous for smallholder farmers to access pertinent information about markets and technology [35]. (4) The fourth challenge relates to unfair trade practices in organic markets. Farmers, due to their weak market position and bargaining power, often encounter unfair regulations imposed by enterprises [35–37]. Additionally, the price premium for organic products tends to benefit large corporate producers disproportionately [38]. (5) The fifth challenge involves the absence of agricultural socialized services. In numerous developing countries, smallholder farmers encounter significant difficulties in participating in organic agriculture due to the lack of available services, such as technology, finance, insurance, and training [27,39]. (6) The sixth challenge pertains to the absence of essential infrastructure and tools, such as inadequate roads, irrigation systems, and agricultural machinery [24,28,40].

China exemplifies a nation characterized by a predominance of smallholder farmers, who encounter numerous challenges in the realms of organic agriculture production and marketing. Notably, Chinese agriculture is marked by two contrasting attributes: the vast number of small farmers and the limited scale of their agricultural operations [41]. The third agricultural census in China, conducted in 2016, revealed that over 98% of the agricultural entities are smallholder farmers, collectively cultivating 70% of the nation's agricultural land, with an average holding size of 0.52 hectares [42]. These smallholder farmers are characterized by their decentralized operations and weak effectiveness [43]. Furthermore, the demographic profile of Chinese farmers predominantly consists of the elderly. Research

findings revealed Chinese farmers had an average age of 51 in 2016, comprising 28% aged over 60 and only 3% under the age of 30 [44]. Given that organic agriculture demands more knowledge, skills, and physical effort compared to conventional farming, older farmers are at a significant disadvantage and thus struggle to meet these rigorous demands.

In southwestern China, the challenges are particularly acute. The southwestern region of China plays a pivotal role in organic agricultural production, contributing 44% to the nation's total organic crop production area [45]. Yet, southwest China stands out as the most fragmented region in terms of agricultural production and ranks among the most economically disadvantaged, characterized by a predominance of smallholder farmers, fewer agribusinesses, and reduced financial resources for local governments. Guizhou province exemplifies these challenges. As a predominantly mountainous area and one of China's poorest regions, Guizhou lacks any plains, with mountains and hills making up 92.5% of its geography and tablelands comprising the remaining 7.5%. Due to the geographical constraints, Guizhou's rural populace faces significant poverty. There is a Chinese saying about Guizhou: "Not three feet of flat land, not a family with three silver coins". Despite governmental claims of eradicating poverty by 2020 [46], Guizhou remains among the least developed provinces. It is, however, pivotal for organic agriculture, boasting 175,500 hectares of organic crops in 2022 and ranking fifth nationally [45].

In Guizhou province, the organic sorghum industry notably distinguishes itself. Primarily centered in Zunyi city, where it represents over 80% of production in Guizhou. Zunyi not only boasts the most extensive organic sorghum cultivation area in China but also engages smallholder farmers almost exclusively in its production. As of June 2023, Zunyi's certified organic sorghum lands spanned nearly 75,000 hectares, making up 45% of China's total organic sorghum area. Despite considerable media attention, academic studies on Zunyi's organic sorghum are scarce. The development model of the organic sorghum industry in Zunyi is a model of mutual collaboration among three major stakeholders—enterprises, government, and farmers—which is referred to as the Enterprise–Government–Farmer (EGF) model in this paper. This approach addresses many challenges smallholder farmers face in organic farming and serves as a benchmark for other Chinese regions. The EGF model in Zunyi can provide lessons and a practical reference for areas with similar environmental and economic contexts.

The aim of this study is to investigate how the EGF model addresses common challenges encountered by smallholder farmers in embracing organic farming. The paper is structured as follows. Section 2 delineates the analytical framework and methodology and introduces the organic sorghum industry in Zunyi. Section 3 delves into the operational mechanism of the EGF model for Zunyi's organic sorghum industry. Section 4 presents the findings of the EGF model, focusing on its efficacy in mitigating challenges faced by smallholder farmers in organic farming practices. Section 5 deliberates the outcomes, and, finally, Section 6 outlines the conclusions and delineates limitations.

2. Materials and Methods

2.1. Research Framework

The research framework of this paper is illustrated in Figure 1. This study comprises four main sections. Firstly, it scrutinizes the emergence of the EGF model for the organic sorghum industry in Zunyi and its subsequent adoption by other liquor companies in the region. Secondly, it outlines the structure of the EGF model, elucidating the roles and interactions among its key stakeholders: enterprises, government, and farmers. Thirdly, it analyzes the operational mechanism of the EGF model, focusing on collaborative efforts in organic zone development and protection, organic sorghum cultivation, and related areas. Lastly, the paper presents the outcomes of the EGF model. This section evaluates the effectiveness of its implementation and assesses its impact on addressing challenges encountered by smallholder farmers in organic farming practices.

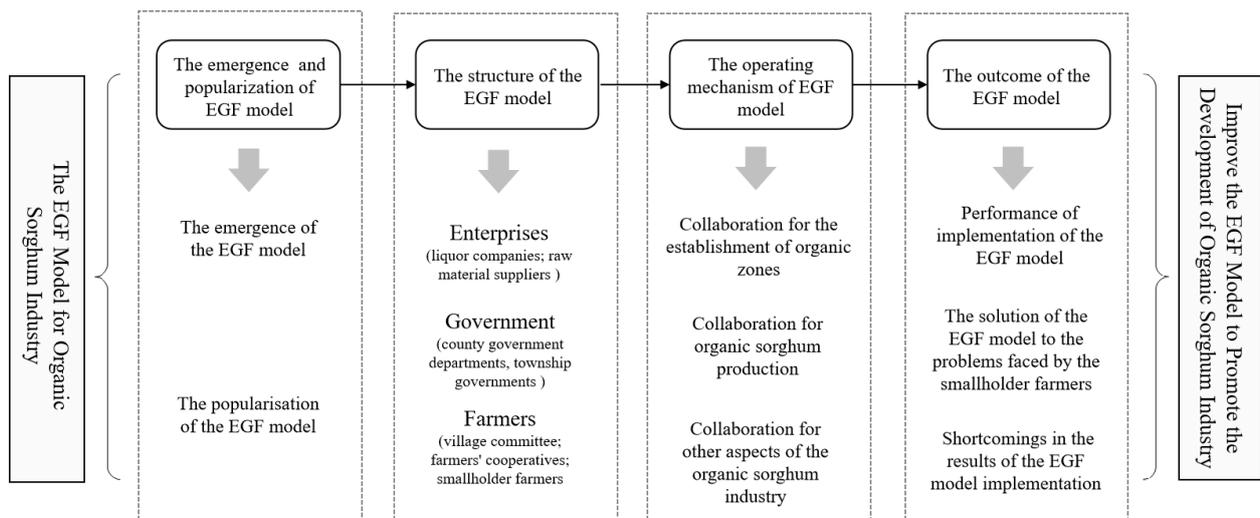


Figure 1. Research framework.

2.2. Methodology

This study employed an integrated research methodology. This approach is commonly employed in case studies. The approach enables a comprehensive description of the events, providing additional information and insights into the context and experience of the case [43,47,48]. The method consists of the following steps.

Step 1: Formulate the research question. To address the primary research objectives, we formulated the following three questions. (1) What are the factors that have contributed to the emergence and adoption of the EGF model within the socio-economic and geographic context of Zunyi? (2) How does the EGF model mitigate the challenges encountered by smallholder farmers in organic farming practices? (3) What are the limitations or potential areas for improvement in the implementation of the EGF model? (4) What is the potential for the application of the EGF model in other comparable regions?

Step 2: Selection of the case study. We selected the organic sorghum industry in Zunyi as the case study. Zunyi is situated on the slopes of the Yunnan–Guizhou Plateau, encompassing an area of 30,762 square kilometers and governing 15 counties (Figure 2). Zunyi ranks as the second largest prefecture-level city in Guizhou province, considering both population and economic factors. In 2022, Zunyi's population reached 6,596,000, with 43% residing in rural areas, accompanied by a per capita GDP of RMB 66,742 (USD 9225). Zunyi possesses a vast, undulating topography with diverse landform types, with the majority of the terrain ranging from 1000 to 1600 m in altitude. Zunyi's terrain predominantly consists of rugged and mountainous areas, with mountains covering 61.9% of the total land area, hills encompassing 30.7%, and tablelands within hills and mountains comprising only 7.4%. According to China's Third National Land Survey (CTNLS) in 2019, Zunyi possesses 634,670.41 hectares of arable land, with a per capita share of 0.096 hectares. The cultivated land includes 19.5% with slopes above 25° and 1.83% with slopes of 2° and below.

Step 3: Data collection methods. Data collection was conducted through three primary methods. (1) Collection of statistical data. We obtained statistical data on organic sorghum and organic liquor from China's National Certification and Accreditation Administration (NCAA). The NCAA is a public organization authorized by the State Council of China to oversee and coordinate certification and accreditation activities across the country. Through the National Certification and Accreditation Information Public Service Platform (NCAIPSP) of the NCAA, we gathered organic sorghum certificates valid for a one-year period from 30 June 2022 to 30 June 2023. We collected a total of 756 organic sorghum certificates, with 444 (58.7%) originating from Zunyi. By analyzing the information from each organic certificate, which included details about area, yield, and location, we obtained data on organic sorghum across China. (2) Conducting field surveys. We conducted field

surveys in Zunyi for a total of 25 days, spanning November 2022 and May 2023. We conducted interviews with government officials, company managers, village cadres, co-operative leaders, and farmers involved in organic sorghum cultivation in each county. Throughout the survey, local governments furnished us with abundant materials pertaining to the organic sorghum industry, including work summary reports and industry-specific reports. (3) Additional methods. In addition, we gathered data and materials relating to organic sorghum from previous news reports, official websites of local governments, and company websites.

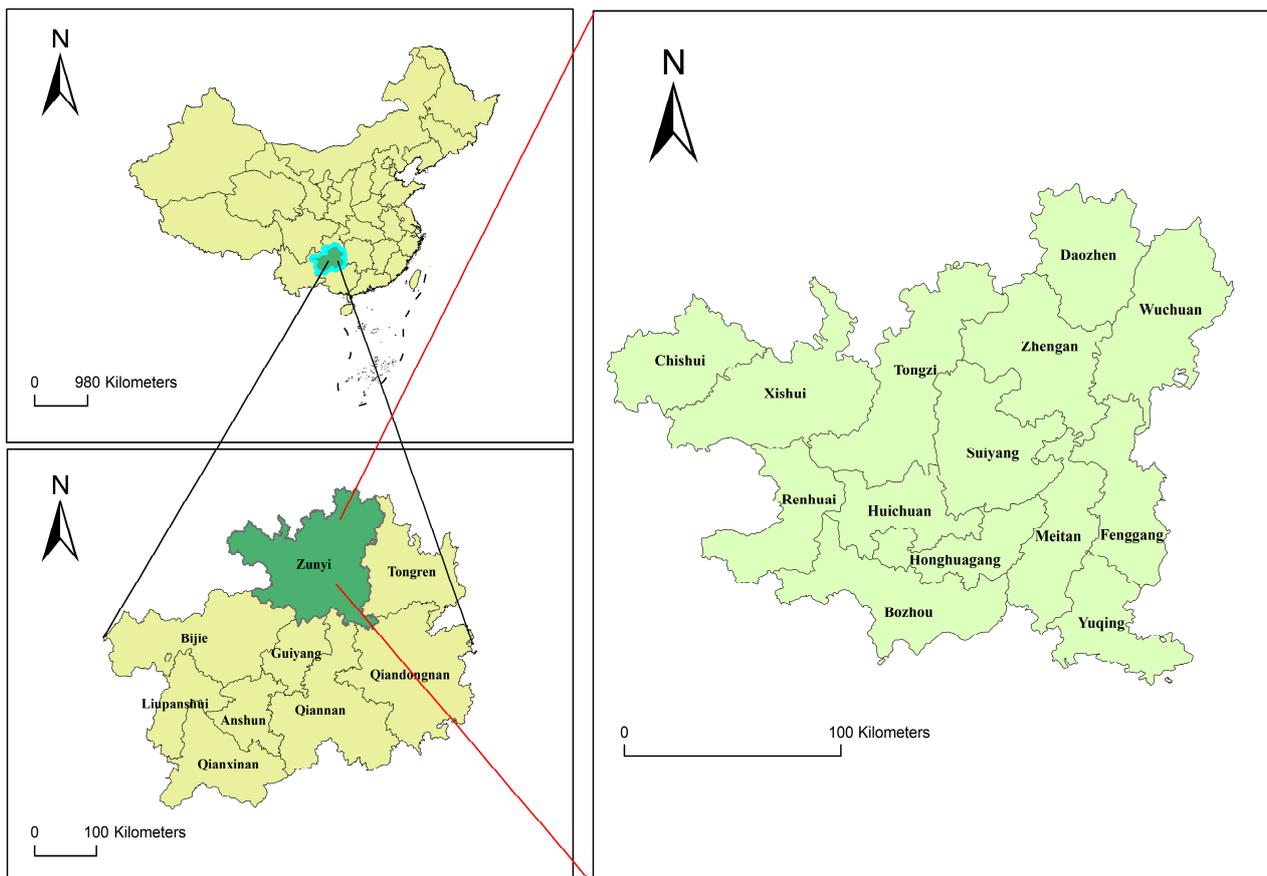


Figure 2. Location of Zunyi city (source: made by the authors).

Step 4: Case study analysis. Utilizing the collected data and materials, we conducted an initial analysis of the emerging process, structure, and operational mechanisms of the EGF model for Zunyi's organic sorghum industry. Subsequently, we analyzed the outcomes resulting from the implementation of the EGF model. Lastly, we compared the findings from the Zunyi case study with studies conducted in other regions, aiming to objectively assess the feasibility and potential applications of the EGF model.

2.3. Case Background

Zunyi is a renowned region in China known for its production of white spirits (also called "baijiu" in China). In 2022, Zunyi had a total of 144 liquor industrial enterprises classified as "above designated size" (referring to enterprises with a main business income of RMB 20,000,000 (USD 2,765,100) or more). These enterprises collectively produced 245,900 kiloliters of white liquor, accounting for 85% of the total white liquor production in the Guizhou province.

Zunyi has a rich history of cultivating sorghum, a key ingredient in the production of white liquor. Based on information provided by the Zunyi government, approximately

100,000 hectares of sorghum were cultivated in Zunyi in 2023, encompassing 15 counties and 217 townships and involving 230,000 farmers.

Organic sorghum serves as the essential raw material for high-end white liquor. The improvement in quality within Zunyi's white liquor industry has generated a demand for high-quality raw materials, thereby fostering the growth of the local organic sorghum industry. Currently, organic sorghum cultivation is extensive across 12 counties within Zunyi (Table 1). As of the end of June 2023, Zunyi possessed a certified organic sorghum area of 74,639.91 hectares, valid within the specified period. The organic sorghum output amounted to 311,446.41 tons.

Table 1. Organic sorghum production in Zunyi.

| County | Production Area (ha) | Yield (tons) |
|-------------|----------------------|--------------|
| Renhuai | 17,758.52 | 66,785.52 |
| Suiyang | 10,371.50 | 58,243.50 |
| Tongzi | 9994.73 | 35,330.60 |
| Xishui | 8713.05 | 32,575.00 |
| Daozhen | 8383.93 | 37,728.90 |
| Wuchuan | 6299.98 | 28,350.00 |
| Bozhou | 5994.08 | 21,703.50 |
| Huichuan | 2415.16 | 9057.25 |
| Fenggang | 2355.73 | 12,847.17 |
| Zhengan | 1543.41 | 5787.97 |
| Meitan | 698.51 | 2619.50 |
| Honghuagang | 111.32 | 417.50 |
| Total | 74,639.91 | 311,446.41 |

Source: National Certification and Accreditation Information Public Service Platform (NCAIPSP) of NCAA.

Zunyi is situated in a mountainous region characterized by scattered arable land, where the majority of organic sorghum cultivation takes place on terraced fields (Figure 3). The geographical limitations present challenges in mechanizing the majority of the arable land, although a small portion of it can be utilized with small agricultural machinery following remediation efforts. The dispersed nature of the arable land necessitates labor-intensive agricultural practices, resulting in increased operational costs. Elevated labor costs have impeded the progress of local family farms, agribusinesses, and other emerging agricultural entities, contributing to the dominance of smallholder farmers in sorghum cultivation. The underdevelopment of the rural economy has led to a significant outmigration of young farmers from Zunyi to more developed regions within China. The majority of farmers engaged in organic sorghum farming are aged over 50 and primarily seeking to generate income to support their families' daily expenses and alleviate the financial burden on their children, who work in regions distant from their hometown.

Given the limited availability of arable land and the scarcity of labor, capital, and technology, individual farmers in Zunyi typically cultivate organic sorghum on a small scale. For instance, Renhuai stands as the county with the highest organic sorghum cultivation area in Zunyi; however, the individual scale of organic sorghum cultivation remains quite modest per farmer (Table 2). In 2024, the cumulative organic sorghum cultivation area in Renhuai accounted for 17,741.80 hectares, encompassing 19 townships, 160 administrative villages, and 51,102 farming households. On average, the organic sorghum cultivation area per family household in Renhuai does not surpass 0.5 hectares. In 2024, the mean organic sorghum cultivation area per household in Renhuai equated to 0.35 hectares, with the smallest plot being 0.07 hectares and the largest reaching 99.27 hectares. Furthermore, 97.08% of households cultivated areas less than 1 hectare, and 80.63% of households operated on plots smaller than 0.5 hectares.

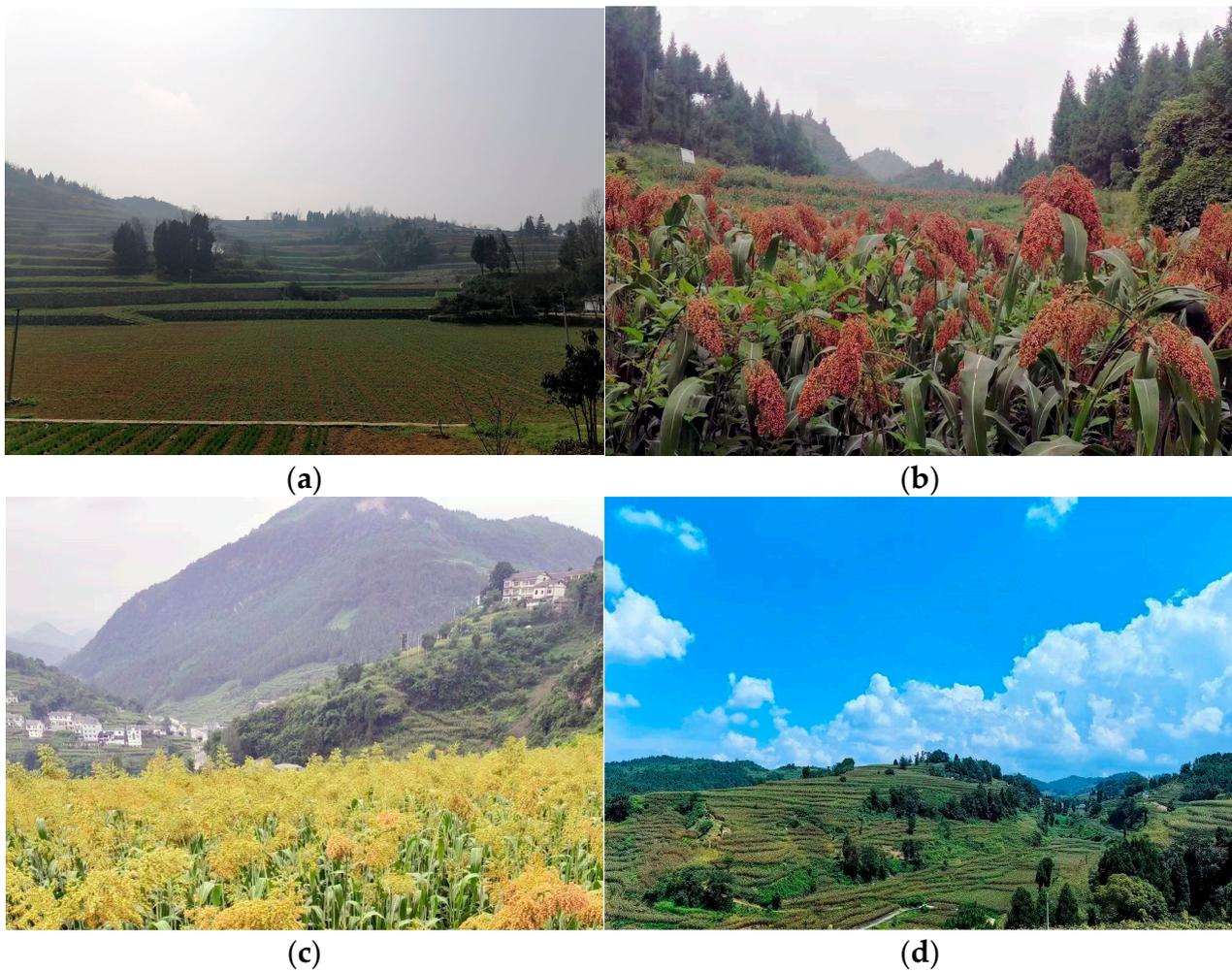


Figure 3. Photographs showcasing organic sorghum in Zunyi. (a) Organic sorghum plots equipped with small-scale farm machinery. (b) Mature organic sorghum. (c) Immature organic sorghum. (d) Organic sorghum grown on terraced fields. (Image source: authors).

Table 2. Area of organic sorghum cultivation by smallholder farmers in Renhuai, Zunyi.

| Year | Number of Households Involved | Total Cultivation Area (ha) | Average Area per Household (ha) | Median Area (ha) | Minimum Area (ha) | Largest Area (ha) | Average Yield (kg) |
|------|-------------------------------|-----------------------------|---------------------------------|------------------|-------------------|-------------------|--------------------|
| 2016 | 34,023 | 12,177.63 | 0.36 | 0.33 | 0.02 | 3.67 | 3420 |
| 2018 | 41,836 | 18,145.90 | 0.43 | 0.33 | 0.02 | 138.67 | 3420 |
| 2020 | 49,766 | 16,875.80 | 0.34 | 0.27 | 0.07 | 113.33 | 3450 |
| 2022 | 39,599 | 13,467.27 | 0.34 | 0.27 | 0.03 | 266.67 | 3480 |
| 2023 | 50,442 | 18,348.40 | 0.36 | 0.27 | 0.03 | 111.43 | 3495 |
| 2024 | 51,102 | 17,741.80 | 0.35 | 0.27 | 0.07 | 99.27 | — |

Note: The decline in total cultivation area in 2022 is primarily due to the impact of the COVID-19 epidemic. Source: average yield data are from the Renhuai Bureau of Statistics, and the rest are from the Renhuai Bureau of Agriculture and Rural Development.

Despite county-level government efforts to promote large-scale farming, the impacts have been less pronounced than expected. As farms expand, farmers encounter escalating costs and risks. Large-scale operations often involve land consolidation, requiring land transfers and rental payments, typically ranging from RMB 3000 (USD 414) to RMB 9000 (USD 1242) per hectare. Additionally, the lands of some large-scale farms are non-contiguous, consisting of multiple disjointed plots that complicate the adoption of mecha-

nized farming and consequently increase labor requirements. Moreover, in recent years, the economic downturn has led some liquor companies to cut back on their demand for organic sorghum, impacting farmers' decisions. Consequently, some large-scale farmers in Zunyi have scaled down their operations, as evidenced by the largest farm in Renhuai, which shrank from 266.67 hectares in 2022 to 99.27 hectares in 2024, as shown in Table 2.

3. The EGF Model for the Organic Sorghum Industry in Zunyi

3.1. The Emergence and Popularity of the EGF Model for the Organic Sorghum Industry

3.1.1. The Emergence of the EGF Model for Organic Sorghum Production

The development of the EGF model for the organic sorghum industry is closely linked to Moutai, a significant company in Zunyi. Zunyi has been a renowned region for liquor production since the Qing Dynasty [49]. Following the establishment of the People's Republic of China in 1949, the local government undertook the nationalization of liquor companies, leading to the merging or reorganization of numerous private liquor companies into state-owned enterprises. During this period, China's rural areas transitioned into a planned economy era, characterized by government control over agricultural production, including sorghum cultivation in Zunyi. During the 1990s, the Chinese government initiated market-oriented reforms, resulting in the privatization of numerous liquor enterprises in Zunyi; however, certain state-owned liquor enterprises were retained. Notably, Moutai stands as the largest state-owned enterprise, and the local governments held the responsibility of ensuring the raw material supply for Moutai. Additionally, some County-level State-owned Grain Supply Enterprises (CSOGSEs) were entrusted with the provision of raw materials for state-owned liquor enterprises.

Organic sorghum cultivation in Zunyi commenced in 2000, propelled by Moutai's organic strategy. To secure a steady supply of organic sorghum raw materials, Moutai collaborated with the Renhuai government to establish organic sorghum production bases. The Renhuai government constructed multiple organic zones within the county and organized smallholder farmers for organic sorghum cultivation. Moutai offers financial support for the establishment of organic zones and organic sorghum cultivation. The village committee, which serves as the primary organization for farmers in administrative villages, assumes the responsibility of assisting the government in coordinating smallholder farmers for organic sorghum production. The CSOGSEs, acting as Moutai's raw material suppliers, were tasked with purchasing organic sorghum from smallholder farmers and delivering it to Moutai. The organic sorghum production process can be described as a collaboration between enterprises (liquor company + raw material supplier), government, and farmers (village committee + smallholder farmers).

Subsequently, the farmers' cooperative became involved in organic sorghum production, assuming the responsibility of supporting the government and village committee in coordinating farmers for organic sorghum cultivation. In 2006, the Chinese government enacted legislation related to farmers' cooperatives and facilitated their establishment in rural areas nationwide [50]. Since then, numerous cooperatives have been established in rural areas of Zunyi in response to impetus from the government.

It is noteworthy that unlike in developed regions of China and abroad, cooperatives in Zunyi are predominantly of the "Village Collective-based" type [51]. Such cooperatives are managed by the village collective, particularly by the village committee, with a village cadre serving as the cooperative's leader. This is primarily attributable to the challenging survival conditions faced by cooperatives in rural areas of Zunyi, characterized by a dearth of economic factors and suitable agricultural industries. The majority of cooperatives depend on supportive government policies, which typically have public objectives. To ensure the effective implementation of these policies, cooperatives are managed by village collectives. However, without the support of the government and village collectives, it is difficult for these cooperatives to survive on their own.

3.1.2. The Popularization of the EGF Model for Organic Sorghum Production in Zunyi

The EGF model pioneered by Maotai was subsequently adopted by other local liquor companies, becoming a widely favored approach to organic sorghum production in Zunyi. Other liquor companies commonly employ the EGF model due to their need to collaborate with farmers and local governments to secure an adequate supply of organic sorghum raw materials.

The regional characteristics of sorghum necessitate the collaboration between liquor companies and local farmers. The liquor produced in Zunyi is a type of Jiang-flavor Chinese white spirit [52], which specifically requires local glutinous sorghum as its raw material. This particular sorghum variety, characterized by a higher amylopectin content, is better suited as a raw material to wine production [53]. While raw sorghum for liquor production may originate from other regions in China or even abroad, local organic sorghum is exclusively employed for high-end liquor production. As farmers own the arable land, companies must collaborate with them to acquire raw organic sorghum.

The presence of high transaction costs between companies and smallholder farmers creates a dependency of companies on the government. Various avenues exist for companies to collaborate with farmers, with one frequently employed approach being land rental for production. However, this method incurs substantial transaction costs. This is primarily attributed to Zunyi, which necessitates a significant labor input in agricultural activities. Initially, some enterprises adopted the strategy of leasing land and engaging local farmers for sorghum cultivation. However, they faced challenges, such as exorbitant land rent and hiring expenses. Compounding the issue, hired farmers exhibit heightened moral hazards in organic sorghum production, including tendencies towards laziness and non-compliance with requirements. These challenges pose difficulties for companies in monitoring operations, ultimately leading to diminished yields and compromised quality.

Another form of cooperation between enterprises and farmers involves the signing of a contract, where farmers undertake the production responsibilities while enterprises purchase their products at a predetermined price. Nevertheless, the implementation of this approach also encounters many challenges. Firstly, the substantial demand for organic sorghum by enterprises necessitates the participation of a considerable number of smallholder farmers in its production. However, organizing and coordinating such a large group of farmers poses challenges for enterprises. For instance, negotiating with individual farmers proves arduous for enterprises due to the time-consuming nature of the process and an occasional lack of trust from farmers. Secondly, despite the prevalence of cooperatives in rural areas of Zunyi, their limited strength and lack of competent managers render them ineffective in organizing and coordinating smallholder farmers. Thirdly, due to constraints in knowledge and cultural factors, certain farmers exhibit a lack of commitment to contractual obligations, frequently resulting in breaches during the organic sorghum production process. Within the socio-economic context of rural China, coercing farmers into compliance is both expensive and socially precarious for firms [41]. These challenges faced by enterprises are beyond their individual capacity to resolve, necessitating intervention from the local government.

3.2. The Structure of the EGF Model for the Organic Sorghum Industry

Figure 4 illustrates the structure of the EGF model employed in the organic sorghum industry of Zunyi. Within this model, enterprises, government, and farmers engage in collaborative efforts, leveraging their synergistic interactions to propel the growth of the organic sorghum industry.

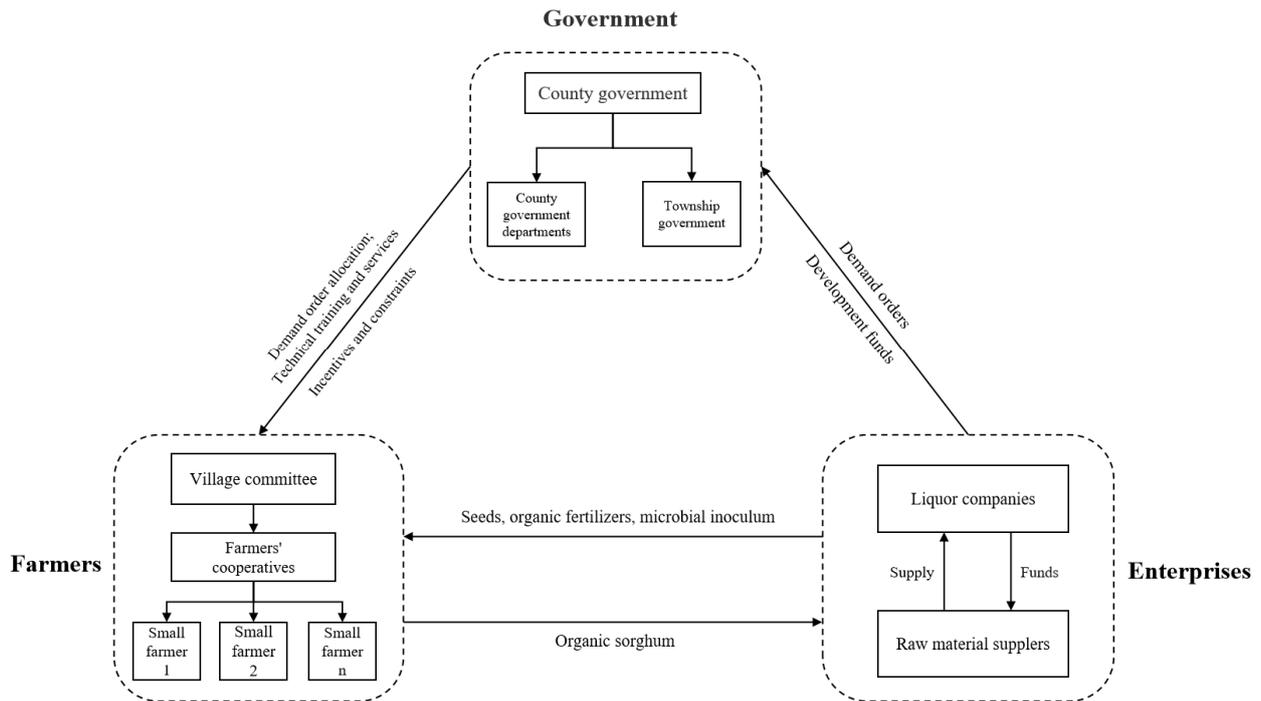


Figure 4. The structure of the EGF model for the organic sorghum industry.

3.2.1. Enterprises

The term “enterprises” encompasses liquor companies and raw material suppliers. Presently, Zunyi hosts thirteen organic-liquor-producing companies, two of which are state-owned. Additionally, there are 20 raw material suppliers involved in organic sorghum, comprising 9 state-owned enterprises and 11 private enterprises. State-owned enterprises are categorized as “enterprises” rather than “government” due to their independent profit-making capabilities, despite being under government supervision.

In the development of the organic sorghum industry, liquor companies shoulder various responsibilities, including placing demand orders for organic sorghum; covering the expenses associated with organic certification and a majority of the costs for material inputs (such as seeds, organic fertilizers, and botanical insecticides) used in production; contributing to the costs incurred in establishing organic zones; and providing financial support to the local government to facilitate the smooth operation of activities related to organic sorghum.

Raw material suppliers function as agents for liquor companies, engaging in the signing of organic contracts with farmers under the supervision of the government. They procure organic sorghum from farmers following the harvest and subsequently deliver it to the respective liquor companies. Additionally, raw material suppliers assume various responsibilities, such as handling organic certification applications, distributing input materials, and providing technical training. It is noteworthy that the majority of raw material suppliers receive a fixed income and are not exposed to market risks.

3.2.2. Government

The term “government” specifically pertains to the county government, whereas the Zunyi municipal government provides supplementary policy support. However, the advancement of the organic sorghum industry primarily hinges on the efforts of county-level governments. The county government comprises county government departments and township governments. The county government departments, including the Agriculture and Rural Affairs Bureau (ARAB), the Market Supervision Bureau (MSB), and the Development and Reform Bureau (DRB), operate under the authority of the county government. Township governments, under the governance of the county government, assume complete

responsibility for public affairs within their respective territories, which encompasses the promotion of rural development.

In the advancement of the organic sorghum industry, local governments assume various responsibilities, including sorghum industry planning, construction of organic zones, market regulation, extension services, and provision of other policy support. Each county government department is accountable for specific aspects pertaining to the organic sorghum industry based on its respective functions. The CARBs, serving as the primary department, assume the responsibility of organizing and implementing pertinent policies to foster the growth of the organic sorghum industry. Township governments bear the responsibility of constructing organic zones, verifying organic land, organizing farmers, providing technical training, and coordinating the activities of farmers within their jurisdiction.

3.2.3. Farmers

The term “farmers” encompasses village committees, cooperatives, and smallholder farmers. We categorize village committees and cooperatives as farmers because, in China, administrative villages are not classified as part of the government sector. Moreover, both village cadres and cooperative leaders are farmers who actively participate in agricultural production activities.

Farmers, as agricultural producers, bear the responsibility of cultivating organic sorghum that adheres to the enterprises’ requirements. Village committees, under the guidance of the township government, assume the responsibility of organizing farmers for organic sorghum production. Cooperatives play a vital role as assistants to the village committees, facilitating the organization of farmers for the execution of production activities. Additionally, cooperatives are accountable for offering technical guidance to smallholder farmers. Smallholder farmers are responsible for organic sorghum production. The production process of organic sorghum encompasses various stages, such as the nursery, sowing, tending, harvesting, and drying.

3.3. Operationalizing the EGF Model for the Organic Sorghum Industry

3.3.1. Collaboration in the Establishment of Organic Zones

The first step in producing organic sorghum involves the establishment of a designated organic zone where organic production methods are implemented and non-compliant inputs are excluded. Because the land is owned by the farmers responsible for cultivating organic sorghum on their land, establishing the organic zone requires collaboration among farmers. Establishing an organic zone involves the following.

Phase 1: Planning organic zones. County governments are responsible for planning organic zones. County governments must communicate with enterprises and farmers multiple times to gather input during the planning process.

Phase 2: Construction activities. Construction activities in organic zones include improving infrastructure (such as roads and irrigation), restoring terraces, and preparing land. Local governments are responsible for constructing organic zones, with financial support provided by liquor companies. Local farmers supply the labor for construction activities and receive payment for their services.

Phase 3: Applying for organic certification. Organic certification is based on the land tenure of individual farmers, which remains constant throughout the process. Most of the costs of organic certification are covered by liquor companies. Raw material suppliers are responsible for applying for organic certification and, upon successful completion, become certificate holders. Cooperatives are responsible for documenting essential information for organic production. Local governments coordinate the certification process. Upon certification, farmers can choose to cultivate organic sorghum on their land, lease it to others, or invest in cooperatives.

Phase 4: Protecting organic land. Within the organic zone, arable land is exclusively allocated for organic sorghum production or crop rotation. Local governments have enacted measures to protect the integrity of organic zones. County governments develop crop

rotation plans based on soil test results, guiding cooperatives and smallholder farmers in regular rotation while strictly prohibiting non-compliant inputs. Some county governments use a Land Information Management System (LIMS) to monitor organic sorghum plots, thus preventing unauthorized changes.

Farmers engage in organic sorghum farming voluntarily. To establish an organic zone, the government must persuade farmers to engage in organic sorghum production. To this end, the government collaborates with enterprises to educate and encourage farmer participation in the organic sorghum sector. Initially, some farmers may have reservations; however, observing the benefits accrued by their peers who cultivate organic sorghum often motivates them to participate as well.

3.3.2. Collaboration in Organic Sorghum Production

After the land within the organic zones is certified, organic sorghum production can commence. Throughout the year, collaboration in organic sorghum production can be categorized into six stages.

Stage 1: Release of organic sorghum demand. At the start of each year, liquor companies formulate their organic sorghum quantity requirements by considering past experience and future expectations. Subsequently, they communicate their demand orders to local governments and raw material suppliers. Simultaneously, the liquor companies procure the necessary input materials in accordance with the demanded sorghum quantity, either through direct purchase or by delegating the task to the raw material suppliers. Subsequently, these input materials are supplied to the farmers.

Stage 2: Distribution of demand orders. After receiving orders from liquor companies for their organic sorghum needs, local governments are responsible for distributing the orders to numerous smallholder farmers. The government benefits in two ways by assuming control over order allocation. Firstly, local governments can streamline organic sorghum development across the county, determining areas that require crop rotation and identifying suitable locations for sorghum cultivation. Secondly, local governments can employ organic sorghum orders as a means of safeguarding the livelihoods of impoverished farmers. Local governments give priority to distributing orders to farmers facing challenging economic conditions, and the income generated from organic sorghum cultivation will contribute to the improvement of their family circumstances.

The distribution process for organic sorghum orders unfolds as follows. Firstly, the CARBs allocate the orders to township governments and mandate them to distribute the orders to administrative villages and farmers in accordance with specific rules. Secondly, each township government allocates orders to administrative villages based on the established rules. Thirdly, under the guidance of the township government, village committees and cooperative leaders allocate orders to individual farmers.

Stage 3: Signing of organic production contracts. Once the order allocation is complete, local governments will facilitate the signing of organic production contracts between raw material suppliers and farmers at a suitable time. Subsequently, upon signing the organic production contract, the raw material supplier will distribute a specific quantity of the input materials to farmers based on their contracted area. Typically, these materials are distributed without charge; however, certain materials may necessitate farmers to share a portion of the cost, which varies depending on the region and enterprise. In the case of Moutai's orders, seeds and botanical insecticides are provided to farmers at no cost, while farmers are responsible for 50% of the expenses associated with fertilizers.

Stage 4: Involves the organization of farmers for production. County governments will issue an implementation plan for organic sorghum production and subsequently request township governments to execute it. Upon receipt of the implementation plan from the county government, township governments will convene village cadres and cooperative leaders to refine it. Under the township government's guidance, village cadres and cooperative leaders organize farmers to produce organic sorghum, ensuring adherence to organic operating procedures. The government and raw material suppliers

will provide necessary training for farmers (including village cadres and cooperative leaders) throughout the entire organic sorghum production process.

Stage 5: Involves the management of organic sorghum. Local governments and raw material suppliers play a significant role throughout the organic sorghum production process to ensure a successful harvest. Generally, county governments will establish county-level working groups for coordination and supervision, while township governments will create service organizations to offer technical guidance and support to smallholder farmers. Certain local governments form Organic Sorghum Service Teams (OSST) consisting of agricultural technicians, township government staff, and raw material suppliers to offer guidance and solutions to smallholder farmers. Furthermore, some local governments employ external resources in diverse ways to support smallholder farmers, including hiring experts to address technical issues and utilizing agricultural drones for organic sorghum spraying.

Stage 6: Pertains to harvesting and marketing. Most smallholder farmers harvest sorghum manually during the ripening season. Smallholder farmers de-vein and sun-dry the harvested organic sorghum before selling it to raw material suppliers. Collection points established by raw material suppliers in townships or villages facilitate the farmers to sell sorghum. Organic sorghum is traded through a blend of traditional and modern methods. Certain companies have implemented Logistics Information Systems (LIS) to manage the organic sorghum trade. Farmers receive payment on their bank card shortly after handing over the organic sorghum to the raw material supplier.

3.3.3. Collaboration in Other Aspects of the Organic Sorghum Industry

Enterprises, government, and farmers also collaborate on technological innovations and in adapting to weather changes. Local governments have partnered with liquor companies and raw material suppliers to conduct various technological innovation activities, such as developing new seeds and researching planting techniques. Research and development outcomes are tested on farmers' land. Once the technology matures, it is disseminated to farmers for implementation.

Agricultural insurance covers all organic sorghum production in Zunyi to mitigate losses from weather fluctuations. Sorghum insurance costs RMB 450 (USD 62) per hectare, with expenses shared among enterprises, county governments, and farmers. Proportions of insurance cost sharing vary among enterprises, governments, and farmers across counties. However, farmers' contributions are consistently below 50%, with some regions exempting farmers from any insurance costs. Farmers are the primary beneficiaries of the insurance, receiving compensation from insurance companies for reduced organic sorghum yields caused by weather fluctuations.

4. Results

4.1. Performance of the Implementation of the EGF Model for Organic Sorghum

4.1.1. Benefits to the Organic Sorghum Industry from the EGF Model

The collaboration between enterprises, government, and farmers has significantly enhanced the development of the organic sorghum industry in terms of quality. Firstly, the EGF model has improved information flow among stakeholders and lowered transaction costs. It has also enabled a balance between supply and demand through organic contracts, ensuring optimal pricing for farmers and preventing market imbalances. Secondly, the EGF model has raised production standards by promoting scientific farming practices. Farmers adhere to technical specifications, benefiting from expert guidance, which has boosted labor productivity. For instance, in 2023, the average yield of organic sorghum in Zunyi reached 3450 kg per hectare, compared to only 1650 kg to 2250 kg between 2001 and 2005. Thirdly, profitability and supportive policies have encouraged the adoption of small-scale mechanization, particularly in plowing. This trend is evident as most farmers now use handheld plows (hand tractors), and cooperatives are increasingly equipped with small-scale machinery like seeders, harvesters, and dryers, enhancing productivity

and addressing labor shortages exacerbated by an aging rural population. Fourthly, the adoption of organic farming techniques has spurred ecological benefits and improved sorghum quality. By eliminating pesticides and synthetic fertilizers, these practices not only safeguard crop safety but also enhance the local agro-ecosystem. From 2015 to 2022, fertilizer use in Zunyi decreased from 222,905 tons to 145,347 tons, a reduction partly attributable to China's eco-agriculture policies but also significantly influenced by the organic sorghum sector.

4.1.2. Benefits to Stakeholders from the EGF Model

Collaboration between enterprises, government, and farmers yields mutual benefits. All three stakeholders have significantly benefited from implementing the EGF model.

1. Smallholder farmers receive more income from the EGF model.

The implementation of the EGF model has enhanced farmers' capacity to engage in organic farming, reduced their material input costs, and increased their income from cultivation. In Zunyi, corn is commonly grown as an alternative to sorghum. Table 3 compares the costs and returns from cultivating both crops. It reveals that organic sorghum yields significantly higher returns than corn, primarily because enterprises support farmers by subsidizing material inputs and offering higher prices for their products.

Table 3. Comparative costs and returns of organic sorghum and corn cultivation.

| Category | Items | Unit | Corn | Organic Sorghum |
|--------------------|--|---------|---------------|-------------------------------------|
| Material inputs | Seeds | RMB/ha | 525 | 405 (borne by enterprise) |
| | Fertilizer | RMB/ha | 3450 | 3300 (enterprise 1650, farmer 1650) |
| | Agrochemical/botanical insecticides | RMB/ha | 450 | 450 (borne by enterprise) |
| | Material cost | RMB/ha | 4425 | 4155 (enterprise 2505, farmer 1650) |
| Labor inputs | Labor required (self-employed) | days/ha | 105 | 165 |
| | Labor price | RMB/day | 130 | 130 |
| | Labor cost | RMB/ha | 13,650 | 21,450 |
| Output | Average yield | kg/ha | 5250 | 3450 |
| | Product price | RMB/kg | 2.5~3.1 | 7.6~11.2 |
| | Output value | RMB/ha | 13,125~16,275 | 26,220~38,640 |
| Revenue and profit | Income of farmers (deducted cost of Material inputs) | RMB/ha | 8700~11,850 | 24,570~36,990 |
| | Profits for farmers (deduction cost of Material and labor costs) | RMB/ha | -4950~-1800 | 3120~15,540 |

Note: The table pertains solely to farmers cultivating their own land, and the agricultural machinery owned by these farmers comprises primarily small hand-operated ploughs, with negligible associated costs. It does not encompass large-scale households, whose input expenses extend to land rental and hired labor. Our survey indicates that the input costs for large-scale households vary from approximately RMB 24,000 (USD 331) to RMB 30,000 (USD 414) per hectare, encompassing both material and labor expenses. Data sources: field surveys, including consultations with smallholder farmers, government personnel, and technicians.

In terms of material input costs, organic sorghum incurs lower expenses than corn. In the production of organic sorghum, enterprises absorb most of the costs, leaving farmers responsible for only half the cost of fertilizer, which amounts to RMB 1650 (USD 228) per hectare. Conversely, in corn production, where there is no enterprise support, farmers must bear the full cost of material inputs, totaling RMB 4155 (USD 573) per hectare.

In terms of labor input costs, organic sorghum is more labor-intensive, costing approximately RMB 21,450 (USD 2960) per hectare, compared to RMB 13,650 (USD 1891) for corn. This higher cost reflects the labor demands: one hectare of organic sorghum requires about 165 days of labor from an average skilled farmer, while corn requires only 105 days. The lower labor requirement for corn is partly because its cultivation permits the use of herbicides, which reduces the need for manual weeding. Additionally, corn is easier to harvest than sorghum.

In terms of output value, organic sorghum significantly outperforms corn per hectare. Despite its relatively low yield of 3450 kg per hectare, organic sorghum commands a high output value due to its elevated price range, varying from RMB 7.6/kg (USD 1.05/kg) to

RMB 11.2/kg (USD 1.55/kg). In contrast, while corn yields are relatively higher at 5250 kg per hectare, its output value is considerably lower due to its lower price range, ranging from RMB 2.5/kg (USD 0.35/kg) to RMB 3.1/kg (USD 0.43/kg).

In terms of farmers' income, smallholder farmers earn between RMB 24,570 (USD 3391) and RMB 36,990 (USD 5104) per hectare from organic sorghum, exceeding that from corn, which ranges from RMB 8700 (USD 1201) to RMB 11,850 (USD 1635) per hectare. Deducting labor costs, corn yields negative profits ranging from RMB −4950 (USD −683) to RMB −1800 (USD −248) per hectare, whereas organic sorghum generates positive profits ranging from RMB 3120 (USD 431) to RMB 15,540 (USD 2144) per hectare.

Farmers are strongly incentivized to cultivate organic sorghum due to its superior operational income. Furthermore, some farmers produce additional sorghum beyond the ordered quantities and market it independently, albeit at a reduced price compared to the ordered quantities.

2. The adoption of the EGF model has enhanced the supply of raw materials to enterprises, thereby augmenting their profitability.

Due to the limited arable land in Zunyi, the local sorghum production falls short of meeting the demands of the regional liquor industry. Approximately 26% of the required raw sorghum must be sourced from external suppliers. However, the quality of sorghum sourced from outside Zunyi does not match that of the locally produced sorghum. Through collaboration with the government and farmers, enterprises gain access to premium-quality organic sorghum, thereby enhancing their profitability.

Liquor companies thrive due to the lucrative market for organic liquor, which commands premium prices. Organic sorghum, utilized in crafting high-end liquor, fetches substantial prices, typically exceeding RMB 1200 (USD 166) per bottle (500 mL specification), and, in some cases, surpassing RMB 2500 (USD 345) per bottle. The primary raw materials for liquor production include sorghum, wheat, and water, with the costs of these materials being relatively modest. Approximately 2.4 kg of sorghum and 2.6 kg of wheat are required to produce 1 L of white liquor. Wheat, being readily available, comes at a comparably low cost of about RMB 3/kg (USD 0.41/kg) to RMB 5/kg (USD 0.69/kg).

In China, the premier organic white liquor is Moutai. The precise cost per bottle of Moutai remains undisclosed due to its status as a trade secret. Historically, Moutai's ex-factory price stood at RMB 969 (USD 134) per bottle, inclusive of costs, taxes, and basic profits, yet its market price soared to RMB 3000 (USD 414) per bottle, resulting in substantial profits for Moutai. By 2023, Moutai boasted a net profit margin of 51%. While other liquor companies in Zunyi may not match Moutai's profitability, Zunyi-based liquor enterprises generally outperform their counterparts across China. According to a report from the Guizhou Liquor Industry Development Promotion Association (GZLIDPA), despite Guizhou's liquor production representing only 4.3% of China's total output in 2022, the region's liquor industry contributed 30% of the nation's liquor sales revenue and 43.9% of its liquor profits [54]. These accomplishments in the Guizhou liquor industry are primarily credited to Zunyi liquor enterprises.

3. The EGF model fosters economic growth, leading to an increase in government tax revenue.

The organic sorghum industry in Zunyi has significantly bolstered local farmers' employment opportunities. By 2023, the sorghum cultivation area in Zunyi had expanded to 106,667 hectares, yielding 368,000 tons and generating an output value of more than RMB 3.1 billion (USD 0.43 billion). The advancement of the sorghum industry in Zunyi has resulted in the employment of 230,000 local farming families, with at least 70% involved in organic sorghum production.

The organic sorghum industry supports the development of the liquor industry, a pivotal sector in Zunyi. In 2022, the value added by the liquor industry in Zunyi amounted to RMB 147.84 billion (USD 20.40 billion), comprising 75.3% of the industrial value added and 33.6% of the city's GDP. Zunyi experienced a GDP growth rate of 3.2% in 2022, marking

a decline of 7.2 percentage points from 2021 due to the COVID-19 epidemic. Notably, the industrial value added by the liquor industry in Zunyi surged by 23.6% in 2022, serving as the primary driver of the city's economic expansion.

The local government receives substantial tax revenues from the liquor industry, as China imposes relatively high taxes on liquor, leading to significant contributions to government revenue. In 2022, tax revenue from the liquor industry in Zunyi constituted 50.8% of the city's total tax revenue. A portion of these funds is allocated to support agriculture, including the organic sorghum industry.

4.2. Solutions Derived from the EGF Model to the Challenges Faced by Smallholders in Organic Farming Practices

Table 4 outlines common challenges encountered by smallholder farmers in organic farming practices and presents the outcomes of the EGF model in mitigating these challenges within the organic sorghum sector in Zunyi. The results indicate that the EGF model significantly alleviates challenges for smallholder farmers in organic agriculture.

Table 4. Results of the EGF model for solving the challenges faced by smallholder farmers related to organic farming practices.

| Prevalent Challenges Faced by Smallholders | Specific Description of the Challenges | Solution to EGF Model in Zunyi | Outcomes of Solving the Challenges |
|--|--|--|---|
| Difficulty in obtaining certification | Deficiency in knowledge, the substantial expenses associated with certification, and the intricate nature of procedures. | Liquor companies bear the cost of certification fees, while raw material suppliers handle the certification application process. | Smallholders are not required to initiate the organic certification process or cover its expenses. |
| Income instability | Inadequate or fluctuating price premiums, absence of a stable and dependable market, and elevated input and transportation costs. | Organic contracts stipulate a minimum purchase price for organic sorghum. Liquor companies assume the majority of material input costs. Raw material suppliers establish collection points in nearby townships or villages for farmers' convenience. | Smallholders enjoy stable incomes and incur minimal expenses for inputs and transportation. |
| Low degree of organization of farmers | Inadequate self-organization among farmers, weak organizational capacity of villages, and elevated transaction costs between enterprises and smallholders. | Local governments have undertaken significant efforts to address this issue, such as organizing and mobilizing smallholders, offering guidance and support to village councils and cooperatives, and facilitating coordination between enterprises and smallholders. | The level of organization among farmers has been improved; village committees and cooperatives have become more proactive in supporting farmers; collaboration between enterprises and smallholders has become more seamless, leading to reduced transaction costs. |
| Unfair market trading | Smallholders have limited bargaining power, resulting in lower crop prices and stricter transaction regulations that disadvantage them. | Local governments engaged in negotiations with enterprises to secure contractual terms advantageous to smallholders. | Smallholders obtained improved contractual terms, including higher prices for their products. |
| Lack of agricultural socialized services | Insufficient education and training, limited technology access, absence of insurance, and inadequate finances. | Local governments and enterprises offer technical assistance and training to smallholders, while also sharing the insurance premiums for their crops. | Smallholders have received training and technical services. They were provided with policy insurance. Additionally, many of them do not require loans, thanks to support from both the government and enterprises. |
| Shortage of infrastructure and tools | Insufficient road infrastructure and scarcity of irrigation systems, agricultural machinery, etc. | Local governments provide infrastructure for organic zones, with enterprises sharing some of the costs. Additionally, local governments subsidize agricultural machinery. | Smallholders are not required to invest in infrastructure; instead, they can utilize many mechanical services offered by cooperatives, most of which are provided free of charge. |

- Smallholder farmers are not required to cover any expenses for organic certification. Liquor companies cover the expenses of organic certification, raw material suppliers handle the application process, and the cooperative records information regarding organic sorghum production. Smallholder farmers are solely responsible for producing organic sorghum in accordance with organic standards. They can seek assistance from cooperative leaders, village cadres, and agricultural technical staff when encountering challenges.
- Smallholder farmers can achieve a stable and significant income through organic sorghum operations. Firstly, organic sorghum is cultivated under contract agreements, mitigating market risks for farmers and ensuring a steady income. Secondly, liquor companies cover the majority of production input costs, alleviating the financial burden of high inputs in organic agriculture for smallholder farmers. Thirdly, smallholder farmers are spared the need to transport organic sorghum over long distances post-harvest; instead, they deliver it to collection points in nearby towns or villages, minimizing transportation expenses. Fourthly, local governments manage the allocation of organic sorghum orders, prioritizing distribution to impoverished farmers, thereby enhancing the livelihoods of those with low incomes.
- Government support has boosted the organization of smallholder farmers and strengthened partnerships between enterprises and farmers. Firstly, government involvement has instilled confidence in smallholder farmers, who are willing to respond to the call of village committees and cooperative leaders. Secondly, government support has bolstered the organizational capabilities of village committees and cooperatives serving smallholder farmers. Under the support of local governments, village committees and cooperatives have standardized their operations and bolstered their capacity to mobilize farmers. Thirdly, government involvement fosters collaboration between smallholder farmers and enterprises. In rural Zunyi, farmers frequently harbor mistrust towards enterprises. However, the government enjoys considerable social credibility within the farming community. Its involvement alleviates smallholder farmers' concerns and facilitates contract agreements between them and enterprises, leading to reduced transaction costs.
- Government involvement enhances farmers' market position and mitigates the unequal trade smallholder farmers encounter when dealing with enterprises. Government support has bolstered farmers' bargaining power. Simultaneously, government intervention has mediated the relationship between enterprises and smallholder farmers, resulting in contracts that benefit farmers. For instance, between 2007 and 2023, collaborative efforts between local governments and farmers resulted in a gradual increase in the purchase price of organic sorghum in Moutai. The price surged from RMB 4.2/kg (USD 0.58/kg) to RMB 11.2/kg (USD 1.55/kg), marking a remarkable increase of 166.7%. In comparison, the average price of corn rose from RMB 1.5/kg (USD 0.2/kg) to RMB 2.92/kg (USD 0.4/kg) during the same period, reflecting an increase of 94.5%. This significant hike substantially boosted farmers' earnings. Additionally, government engagement minimizes enterprise defaults and forestalls occurrences like "malicious refusal" and "cheating farmers".
- Smallholder farmers have access to technical training, financial assistance, insurance, and various other services. Regarding technical support, smallholder farmers benefit from a diverse array of services provided by the government, enterprises, cooperatives, and research institutes. Local governments and enterprises collaborate in delivering technical training to farmers, resulting in the development of numerous skilled farmers. Financially, most smallholder farmers forego the need for loans because enterprises cover many material input expenses. Additionally, larger households requiring loans can access them, as Zunyi city hosts numerous commercial banks offering sorghum credit programs tailored for large-scale households and enterprises. Regarding insurance, farmers benefit from policy-backed agricultural insurance, with the majority of

the costs covered by the government and enterprises, leaving smallholder farmers responsible for only a nominal portion of the expenses.

- Smallholder farmers were provided with essential infrastructure and equipment for sorghum cultivation. Local governments have enhanced infrastructure, including roads and irrigation systems, and installed numerous insecticidal lamps within organic zones, with enterprises sharing some of the costs. Local governments offer subsidies to cooperatives for purchasing agricultural machinery, which the cooperatives can utilize to offer services to smallholder farmers.

4.3. Shortcomings in the Results of the EGF Model's Implementation

Despite the successes achieved through implementing the EGF model for Zunyi's organic sorghum industry, certain shortcomings persist. (1) Numerous elderly farmers exhibit limited engagement in collaboration efforts. The majority of organic sorghum producers are older individuals with limited literacy and knowledge levels, contributing to their reluctance to voice their opinions. For instance, while the local government solicits input from farmers during policy development, the majority refrain from offering their ideas. (2) Despite substantial efforts by local governments to improve infrastructure in organic zones, irrigation remains insufficient due to geographical constraints. Due to the hilly terrain of many organic sorghum plots, constructing irrigation systems is prohibitively expensive. Presently, numerous croplands in organic zones continue to lack reliable irrigation systems. (3) The organic sorghum industry encounters challenges from fluctuations in the liquor consumer market. Recent global economic downturns have adversely affected the liquor industry in Zunyi, directly impacting organic sorghum demand from liquor companies. Consequently, reduced demand has hindered some farmers from securing organic sorghum orders. Currently, local governments are implementing measures to address this issue by optimizing order distribution, such as assigning orders to different farmers annually and encouraging those without orders to rotate crops on their land.

5. Discussion

5.1. Similarities and Differences between the EGF Model and Other Practices

In China, three primary collaborative models exist between enterprises and farmers in agro-industrial development [55–57]. (1) In the “enterprise + farmers” model, enterprises and farmers enter into agreements where the enterprise purchases the farmers' agricultural products at contracted prices. (2) The “enterprise + production base + farmers” model involves enterprises leasing farmers' land and employing them, thereby integrating them into the production base. (3) In the “enterprise + cooperative + farmers” model, enterprises engage with farmers through cooperatives. Model (1) is straightforward to implement, yet both enterprises and farmers are susceptible to opportunistic behavior and collaboration issues [58–60]. In model (2), enterprises must cover land rent and wages for farmers, making it suitable for regions and industries with low land, labor, and management costs [57]. Model (3) not only saves enterprises' costs for land rent, labor wages, and management, but also mitigates the risks and expenses of direct interaction with farmers [57,61,62].

The EGF model offers numerous advantages over the aforementioned three models. Besides the benefits of model (3), the EGF model boasts two additional advantages. Firstly, government involvement provides smallholder farmers with policy support and enhances their capacity to participate in organic agriculture. Secondly, government intervention fosters collaboration between enterprises and smallholder farmers, thereby mitigating opportunistic behavior from either party. Notably, the EGF model is most suitable for regions characterized by decentralized smallholder production and necessitating government intervention.

Similar collaborative practices are observed in organic farming in Wanzai county, Jiangxi Province [63,64]. Nonetheless, the Wanzai county's government's involvement in organic farming was relatively brief, followed by a reduction in intervention. Initially, during the inception of organic agriculture, the Wanzai government offered substantial support

to small farmers, encompassing technical training, incentivizing cooperative formation, and facilitating negotiations with enterprises [63]. However, as the organic agriculture sector matured, governmental intervention and influence diminished [63,64]. Two reasons may account for why the Wanzai government allowed the organic agriculture industry to develop independently. Firstly, Wanzai county's location in southeast China, surrounded by economically developed regions, has led to the establishment of a robust local market system for organic agriculture over time, rendering excessive government intervention unnecessary. Secondly, the prevalence of smallholder farmers in Wanzai is lower compared to Zunyi, resulting in less severe challenges in organic farming practices.

Throughout China's Poverty Alleviation Campaign (2016–2020), numerous approaches resembling the EGF model were deployed in western China. Industrial poverty alleviation serves as a crucial method for rural poverty reduction in China, wherein the government offers policy support to enterprises while mandating them to forge mutually beneficial relationships with farmers [65–67]. Typically, this entails purchasing agricultural products from impoverished households at fixed prices. Consequently, impoverished households receive a steady income, thereby facilitating their exit from poverty. Nonetheless, the collaboration in industrial poverty alleviation is government-driven, yet this approach often proves ineffective in practice, as many enterprises prioritize profit-making through compliance with government mandates rather than fostering genuine partnerships with farmers [68,69]. Consequently, numerous enterprises and farmers fail to establish a mutually beneficial profit-sharing mechanism, resulting in the dissolution of partnerships once support policies are discontinued. While county governments in Zunyi utilized the organic sorghum industry as a poverty reduction strategy, significant disparities exist between the EGF model and industrial poverty alleviation collaboration. A noteworthy distinction lies in the market-driven nature of the EGF model for the organic sorghum industry, characterized by well-defined roles among firms, government, and farmers, along with a robust linkage mechanism.

5.2. Potential Application of the EGF Model

China has a vast population of smallholder farmers, a characteristic expected to persist for the foreseeable future. Currently, China is striving to steer agriculture towards sustainability, with organic agriculture emerging as a pathway towards this objective. Facilitating improved participation of smallholder farmers in organic farming is paramount for the advancement of organic agriculture in China. The EGF model for organic sorghum production in Zunyi serves as a practical benchmark for advancing organic agriculture in other Chinese regions.

The EGF model has been implemented in various areas across China beyond Zunyi. A comparable approach to the EGF model has been embraced for organic sorghum production in regions like Qianxinan and Tongren in Guizhou province. In Wanzai county, Jiangxi province, the local government attracts enterprises to invest in organic agriculture while also fostering collaboration between farmers and enterprises. In Xichong county, Sichuan province, local governments actively engage in organic agriculture development, offering substantial policy support to smallholder farmers and enterprises [70]. In these regions, intimate collaborative partnerships have been forged among enterprises, local governments, and farmers.

The EGF model might be better suited to implementation in regions characterized by numerous smallholder farmers and decentralized agricultural activities, particularly in areas of western China. This can be attributed to several economic and social factors prevalent in western China, including the widespread dispersion of arable land, a relatively underdeveloped economy, and the predominance of small-scale farming operations. These characteristics of rural areas in western China require collaboration among stakeholders in order to promote economic development in these areas. Organic agriculture is a knowledge- and technology-intensive sector that poses grand challenges for smallholder farmers to

navigate in western China [71]. Effective advancement of organic agriculture necessitates collaboration among stakeholders, especially among enterprises, government, and farmers.

The experience gained from the organic sorghum industry in Zunyi could serve as a valuable reference for organic farming initiatives in other developing nations. The involvement of numerous smallholder farmers in organic agriculture is a prevalent trend in many developing nations. Within these countries and regions, smallholder farmers encounter numerous challenges in the pursuit of organic agriculture development. Failure to effectively address these challenges will inevitably hinder the healthy and sustainable growth of organic agriculture. Active government involvement and collaborative efforts between enterprises and farmers could offer an alternative approach to fostering organic agriculture development in these nations and regions.

6. Conclusions and Limitations

6.1. Conclusions

Numerous smallholder farmers participate in organic farming, a prevalent practice in numerous developing nations. Nevertheless, smallholder farmers encounter many significant challenges in embracing organic farming practices. These issues have hindered the swift progress of organic agriculture in numerous developing nations. Using the organic sorghum industry in Zunyi, China as a case study, this paper illustrates how collaborative efforts among enterprises, government, and farmers can address the common challenges encountered by smallholder farmers in organic farming.

The development of the EGF model for the organic sorghum industry in Zunyi is closely linked to Moutai, a major liquor company in the region. In 2000, to secure a steady supply of organic sorghum raw materials, Moutai collaborated with local government and farmers to produce organic sorghum, thereby establishing the “enterprises + government + farmers” collaboration model, commonly referred to as the EGF model. Subsequently, this model became widely adopted by other liquor companies in Zunyi. The EGF model for the organic sorghum industry entails a clear delineation of responsibilities among enterprises, government, and farmers, who work together to achieve mutually beneficial outcomes. The collaborative synergy fosters the high-quality development of the organic sorghum industry in Zunyi. Importantly, the EGF model effectively addresses numerous common challenges encountered by smallholder farmers in organic farming practices. However, local socio-economic and geographic conditions have resulted in some shortcomings in the effectiveness of the implementation of the EGF model in Zunyi, such as low initiative among older farmers and insufficient irrigation systems. The EGF model implemented for the organic sorghum industry in Zunyi serves as a practical reference for the advancement of organic agriculture in analogous regions. Presently, numerous regions across China beyond Zunyi have adopted practices akin to the EGF model.

Drawing from the organic sorghum industry in Zunyi as a case study, the subsequent policy implications are outlined. (1) Government support for smallholder farmers is essential, particularly in regions characterized by dispersed agricultural production and less-developed economies. In such areas, the organic agriculture markets often exhibit numerous imperfections that necessitate government intervention. Considering the myriad challenges encountered by smallholder farmers in organic agriculture, it is imperative for governments to extend support to them, while companies should fulfill their social responsibility by allocating a portion of their profits to smallholder farmers. Emphasizing the role of local governments is crucial, as they directly serve both smallholder farmers and enterprises. (2) The collaborative relationships among enterprises, government, and farmers merit attention. Organic agriculture development is a multifaceted system, necessitating collaboration among various stakeholders to address the numerous challenges encountered by smallholder farmers. While stakeholders in organic agriculture vary across regions, particular emphasis should be placed on the relationship between enterprises, government, and farmers, particularly in developing countries characterized by a majority of smallholder farmers. (3) Promote greater initiative among smallholder farmers to engage

in collaboration. In numerous regions of China, including Zunyi, smallholder farmers exhibit a lack of initiative in external interaction. They rarely initiate communication with government and enterprises to convey their views and opinions, instead passively accepting outcomes. Smallholder farmers should be incentivized to actively engage with government and enterprises. Moreover, enhancing vocational training for farmers and fostering a greater number of young individuals to pursue farming as a career are imperative to bolstering farmers' initiative and creativity.

6.2. Limitations

This study primarily examines generalized situations, with other exceptions remaining unexamined. For instance, in the EGF model of the organic sorghum industry, liquor companies might not directly participate in the collaboration. In such instances, the raw material supplier takes on the role of providing demand orders and assumes all responsibilities typically held by liquor companies. In contrast to the scenario examined in this paper, in this case, the raw material supplier bears the market risk.

This paper underscores the significant potential of the EGF model in alleviating the challenges encountered by smallholder farmers in organic farming practices. However, its effectiveness remains subject to objective and accurate evaluation. Furthermore, due to data acquisition challenges, this study could not comprehensively compare the potential of the EGF model with cases in other developing countries. Moving forward, quantitative analyses relying on comprehensive data will be instrumental in validating the effectiveness of the EGF model. Simultaneously, conducting additional comparative studies on similar cases is essential to evaluate the feasibility of the EGF model and refine the implementation framework.

Author Contributions: Conceptualization, S.W. and S.L.; methodology, S.L.; software, S.L.; validation, S.W.; formal analysis, S.W.; investigation, S.W.; resources, S.W.; data curation, S.W.; writing—original draft preparation, S.W.; writing—review and editing, S.L. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data that are presented in this study are available from the correspondence author upon request.

Conflicts of Interest: The authors declare no conflicts of interest.

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