From an Introduced Pulse Variety to the Principal Local Agricultural Industry: A Case Study of Red Kidney Beans in Kelan, China

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Abstract: The development of introduced pulse varieties has made valuable contributions to the development of the global agricultural industry, and China is one of the largest pulse producers in the international market. A special type of pulse, the red kidney bean, has made a major contribution to improving the rural economy. Taking Kelan County, Shanxi Province, as an example, this paper expounds on the formation of the kidney bean industry and its impact on local development. The existing research used a qualitative case study (QCS) method to examine the driver and impact of kidney beans in the agricultural industry. This study found that (1) the development of the kidney bean industry has benefited from its adherence to a market demand-oriented strategy, focusing on breeding and retaining excellent varieties, and vigorously supporting the construction of technical systems and the cultivation of the main body of the industrial chain. Developing new varieties, creating brands, and industrial integration are the key driving forces for development. (2) The kidney bean industry promotes local development by increasing farmers’ income, forming a more complete kidney bean supply chain, highlighting the brand effect, and promoting sustainable rural development. This study suggests that disease-resistant and mechanized-adapted varieties need to be developed in the future. Market and demand trends should be constantly monitored when determining reproductive paths.

Keywords: cash crops; kidney bean; qualitative case study; driving forces; rural China; Kelan

1. Introduction

The world population is projected to reach 9.8 billion in 2050, and 11.2 billion in 2100 [1–3]. Almost all population growth will occur in low and middle-income countries, which will experience the largest relative increases in the world [4,5]. Two future demographic trends are critical to understanding the challenges of feeding the world: (1) Populations will become increasingly urbanized, with populations in cities and large towns growing faster than rural populations; (2) people will become richer and will use the increased income to buy food that requires more resources to produce. The challenge of feeding the future population is controversial. Some worry that crop yields, especially under climate change, will not be enough to keep up with the demand for food, feed, and...
fiber [5]. Others argue that it should be much easier to feed the world in the future, given important technological innovations and an increased capacity worldwide. While there is a considerable consensus that overall food supplies can be met in the medium term, prolonged constraints on food supplies, and more severe supply shocks due to natural resource constraints and humanitarian crises, will require innovative solutions.

Additionally, in a world of increasing competition for dwindling resources, for healthier diets, sustainable food systems will need to meet the growing demand for more nutritious foods, such as meat and vegetables, for which the resource requirements are higher, and sustainable methods to protect the environment will also need to be used [6]. Edible pulses include all pulses grown in China for human consumption, including dry grains or vegetables and excepting soybeans and peanuts. China has a vast territory and complex ecological conditions. The rotation, intercropping, and mixed cropping of beans are the normal cropping systems in China [7]. Whether native or exotic, pulses have played an important role in China’s planting system since antiquity and have made important contributions to human food resources. Pulses are an important part of sustainable diets and growing systems [7].

The introduction of new crop varieties at national and international levels and the improvement of these new crops have made important contributions to the development of local agricultural industries [8]. In Africa, the introduction of improved cowpeas in Nigeria had a positive impact on income growth and poverty reduction [9]. In Ethiopia and Tanzania, farmers’ adoption of improved pulses increased production, consumption, and farmer welfare [10,11]. The introduction of new pulse varieties also greatly enhances the food security of countries [12]. In Asia, the International Centre for Maize and Wheat Improvement (CIMMYT) introduced mung bean to Nepal, which subsequently improved the nutritional inputs and local farmers’ income [13,14]. Likewise, in India, the introduction of French beans into the sugarcane growing system has greatly improved the income of farmers as well as the ecosystem sustainability [15,16].

China, as a major producer of beans, grows more than 20 kinds of beans, including mung beans, red pinto beans, kidney beans, broad beans, and peas. At present, pulses account for about 2% of the country’s grain cultivation area. Bean planting areas are mainly distributed in ethnic minority areas, border areas, and poor and underdeveloped areas [17]. The planting area of beans in these regions accounts for 65.35% of the total bean-planting area in the country [18,19]. Pulse production and cultivation are highly concentrated and smallholder production is the key mode of pulse farming and the main source of farmers’ income.

Kidney beans are an important type of pulse farming in China where the annual planting area of domestic kidney beans is about 80,000 hectares, and the annual output is about 110,000 tons. This planting area is mainly distributed in northern Shanxi, northern Hebei, central and eastern Inner Mongolia, and northeastern Heilongjiang. Despite the widespread bean production and its importance to rural livelihoods, there is a lack of comprehensive and rigorous evidence to study the mechanisms and impacts of the introduction, selection, and breeding of kidney bean varieties on local development. In this regard, assessing the drivers and impact of the red kidney bean industry on local development is crucial, as it measures the degree to which the variety affects household welfare [20].

The article is separated into four portions. After the introduction, Section 2 describes the research design and methodology, Section 3 presents the results of the study, and finally, Section 4 outlines the discussion and conclusions of the study.

2. Research Design and Methodology

2.1. Case Selection

We selected Kelan (KL) county for the case study, which is a county located in the southwest region of Xinzhou prefecture, with a total area of 1980 square meters and a total population is 80,000 [21,22]. The northwest of Shanxi is a Loess Plateau, which is high in the southeast and low in the northwest. Administratively, KL has jurisdiction
over 12 townships, including 237 villages. In 2020, the city’s total agricultural output value (including crops, forestry, and animal husbandry) was 841 million yuan, and the total cultivated area was 29,333.3 hectares. Almost 95% of the arable land area (about 22,266.7 hectares) is used for food production, mainly maize, potatoes, kidney beans, and millet.

KL is one of the major kidney bean-producing areas; its annual kidney bean production accounts for about one-fifth of its total production [21,22], with 8666.7 hectares planted for six consecutive years from 2008 to 2013 and 6666.7 hectares per year from 2013 to 2020. Farmers in KL plant an average of 0.13 hectares per household, accounting for 29% of the farmer’s total arable land. The average output can reach about 15,000 tons, accounting for about one-third of the total domestic exports, and the annual export earnings are about 43.84 million yuan (the average level of the past five years). KL is China’s main export base for kidney beans; in October 2012, the national quality of the General Administration of Quality Supervision, Inspection, and Quarantine (GAQSIQ) awarded KL the “national demonstration zone for the quality and safety of exported kidney beans”. In April 2013, “KL Kidney Bean” was further certified as a National Geographical Indication Product. KL kidney beans feature high protein, low fat, zero cholesterol, high potassium, low sodium, large seeds, bright color, high nutritional value, and long-term soaking in water will not fade their color. KL kidney beans have been sold to the European Union (EU), Russia, America, and Southeast Asian markets. Essentially, Chinese red kidney beans have become popular with consumers around the world.

2.2. Data and Document Collection

The use of multiple data sources has been described as a distinguishing feature of case studies [23]. According to Stake [23], various data sources are collected and analyzed to gain multiple perspectives and perspectives to gain a comprehensive understanding of the phenomenon under study. We followed the editorial analysis style proposed by Crabtree [24], combined with the qualitative data analysis described by Stake [23]. Our data mainly originates from focus group interviews, individual interviews, documents from local governments and research institutions, and some open-source documents. Table 1 provides a detailed list of the data sources and their main contents.

For the existing study, all the interviews were conducted through four primary sources from 2019 to 2020. First, we interviewed several kidney bean farmers. We selected 250 kidney bean farmers from six townships (about 20 administrative villages). The interviews included the source of kidney bean seeds, seed price, farmers’ input-output ratio of kidney bean planting, participation in relevant technical training, the purchase price of kidney beans, and demand for new varieties of kidney beans. Second, we interviewed about 20 village cadres, mostly related to kidney bean planting areas, kidney bean circulation, and village-level kidney bean production land endowments (or resources). Third, we interviewed several experts, including breeders, three national breeders, and two local breeders. The interviews covered the entire process of the improvement and selection of new kidney bean varieties, the cooperation with local (county and township) governments, and the cooperation with farmers regarding variety improvement, crop variety promotion, and breeding. Fourth, we interviewed eight local agricultural technology extension personnel. The interviews focused on breeding, technical guidance, seed sources, and extension issues.

Concerning other documents, we retrieved relevant information from three main data sources. First, we retrieved local county government work reports from 2010 to 2021, focusing on county-level policy measures, scientific and technological cooperation, and financial support for the development of kidney beans. Second, we retrieved the summary report of the local county agriculture and rural bureau. These reports mainly covered local agricultural development statistics from 2010 to 2021, including the establishment of kidney bean demonstration areas, planting statistics, operating entities, and other kidney bean processing entities. Third, we retrieved a large number of local enterprise development summaries in 2020, recording the enterprise’s variety selection, new variety promotion,
farmers’ cooperation, processing and marketing, and enterprise development business models. In addition, the data from academic institutions were mainly compiled from the 2018 kidney bean research report of the Chinese academy of agricultural sciences and the kidney bean technology summary report of Shanxi agricultural university. Local socio-economic background data, including per capita income, acreage and yield, and the number of agricultural fertilizer inputs across the country, were collected from the KL County Government and the National Bureau of Statistics.

Table 1. Data sources and main contents.

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Data Sources</th>
<th>Main Contents</th>
<th>Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interview data</td>
<td>Interviews with farming households</td>
<td>The source of kidney bean seeds, seed prices, farmers’ kidney bean cultivation input-output ratio, participation in technical training, kidney bean purchase prices, and demand for new varieties</td>
<td>250 households, covering six townships and 20 villages</td>
</tr>
<tr>
<td></td>
<td>Interviews with village cadres</td>
<td>The area of kidney bean cultivation at the village level, the circulation of kidney beans, and the land resources at the village level The process of improving and selecting varieties, cooperation with local government, cooperation with farmers on improving varieties, promotion of crop varieties, and breeding issues</td>
<td>20 village cadres</td>
</tr>
<tr>
<td></td>
<td>Interviews with breeding experts</td>
<td>Breeding, technical guidance, seed sources, and promotion problems</td>
<td>3 national-level and 2 local breeding experts</td>
</tr>
<tr>
<td></td>
<td>Interviews with technology extension staff</td>
<td>County government work reports</td>
<td>8 technology extension staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Including policy initiatives at the county level, science and technology cooperation, and financial support for the year Including the effectiveness of agricultural development, such as the construction of the demonstration area of kidney beans, sowing situation, the situation of business entities, processing, etc.</td>
<td>2010–2021</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Summary report of the Bureau of Agriculture and Rural Affairs</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Enterprise development summary</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Including enterprises in variety selection, variety promotion, farmer cooperation, processing and marketing, business operations, etc.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Research reports on kidney beans</td>
<td>Including the summary of data related to farmer research</td>
<td>2018–2021</td>
</tr>
<tr>
<td></td>
<td>Summary report on kidney bean technology</td>
<td>Including technical summaries and future directions of breeding experts in variety selection and breeding</td>
<td>2018–2021</td>
</tr>
<tr>
<td>Documents from academic institutions</td>
<td>KL bureau of statistics, and the National Bureau of Statistics</td>
<td>KL County’s per capita income, cultivated area, production, and other related data</td>
<td>2018–2020</td>
</tr>
</tbody>
</table>

2.3. Qualitative Case Study

We conducted a qualitative case study (QCS) approach to explore “bounded systems” or cases over time through detailed, in-depth data collection involving multiple sources of information, each with its own sampling, data collection, and analysis strategies [25, 26]. Conspicuously, the use of QCS methods by researchers has increased over the past decade [27]. The study was interpretive; thus, the structure emerged from the interview data rather than being determined in advance. Furthermore, the phenomena explored were understood through participant-specified meanings rather than survey instruments. As asserted by Stake [23], Merriam [28], and Yin [29], the case study approach allows for a holistic understanding of phenomena in real-life settings from the perspective of the people involved [30, 31].
3. Results of the Study

In this section, we have presented results on different stages of kidney bean development, the driving forces of kidney bean development, and the contribution of the kidney bean industry to the local development of KL county.

3.1. Stages of Kidney Bean Development in KL County

Summarizing the improvement process of the kidney bean industry in KL County, in this study, we describe its growth model in five stages from variety introduction to improvement. This process also reflects the continuous evolution of the kidney bean industry in KL County.

3.1.1. Flax and Sunflower as Pillar Industries (from the 1980s to 1990s)

Before planting kidney beans, farmers in KL county primarily planted crops such as sunflower, corn, flax, and potatoes. Flax and sunflower are two outstanding and dominant cash crops. For example, in the early 1980s, the flax planting area in the county was about 100,000 mu. However, by the mid-1980s, a disease that widely affected flax production began to emerge. With limited options for pesticides or herbicides, local flax cultivation became increasingly labor-intensive to control disease outbreaks. Though, as the market demand slowly declined, farmers gradually abandoned flax to grow sunflowers. Unfortunately, around 1996, sunflowers were infected with Scleractinia on a large scale, resulting in reduced yields and even failure. The “premature death” of flax and sunflower created the necessary conditions for the emergence of kidney beans.

3.1.2. The Experimental and Exploratory Stage of the Kidney Bean Industry (from the 1990s to 1996)

Table 2 shows that in 1991, a cluster of British kidney bean varieties was introduced to KL County by a foreign trade company [32]. The promotion of British kidney bean varieties was encouraged by the local government of KL County. In 1992, more than 30 farmers tried to plant kidney beans with purchase orders. This helped these early adopters earn a profit of 4500 yuan per hectare. In 1993, the planting of kidney beans was further expanded to Sanjing Town. The highest unit price of kidney beans is about 2 yuan per kilogram, and the highest yield can reach 2250 kg per hectare. Compared to other staple crops, kidney beans offer farmers the most returns.

Table 2. The comparison between staple crops and kidney beans.

<table>
<thead>
<tr>
<th>Year</th>
<th>Staple Crops (Wheat, Rice, and Maize) Yuan/kg</th>
<th>Kidney Beans Yuan/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>0.537</td>
<td>2</td>
</tr>
</tbody>
</table>

Note: Database of state statistics bureau of China.

3.1.3. The Rapid Growth of the Kidney Bean Industry (from 1996 to 2002)

Figure 1 displays the duration period. The county party committee (CPC) and the local agricultural committee organized township secretaries and agricultural cadres to visit Sanjing Town regularly to learn kidney bean planting techniques. In addition, they provide technical and informational support to large kidney bean farms. Through these efforts, the planting area of kidney beans in KL County has grown steadily and gradually became a stable industry in the following years.
3.1.3. The Rapid Growth of the Kidney Bean Industry (from 1996 to 2002)

The development of the KL kidney bean industry has led to the planting of kidney beans in surrounding counties such as Wuzhai, Shench, Ningwu, Lanxian, etc., with a total area of 13333 hectares of kidney beans. Shanxi Province and Xinzhou City jointly revitalize grains, build a “city of grains”, and help the industrialization of kidney beans. Later, an industrialized business model of “company + cooperative + farm-base + farmer + standardization + brand sales” was formed. In addition, a special kidney bean belt and its production and sales distribution center centered in KL County were formed, as shown in Figure 1.

3.1.4. From Quantity to Quality: A New Era of Kidney Bean (from 2003 to 2010)

The research shows that since 2003, KL County has effectively promoted kidney bean production by introducing new varieties, building high-quality demonstration areas, promoting advanced cultivation techniques, and supporting the development of large-scale producers and traders. In 2004, the planting area increased to 6000 hectares, accounting for 23.8% of the total planting area of crops. From 2005 to 2010, the planting area of kidney beans in the county remained above 6666.7 hectares. In August 2010, the KL County Government signed a “three-in-one” cooperation agreement with Shanxi agricultural university and the Shanxi academy of agricultural sciences to carry out cooperative efforts toward research, demonstration, promotion, and standardized production systems. They jointly formulated the “Shanxi Province agricultural technology promotion demonstration action” project, and later jointly established the National pulse modern agricultural technology system (NPTS) KL Test Station. In January 2010, KL County was awarded the title of “China’s number one red kidney bean county” by the China grain association, signaling that the development of the kidney bean industry has entered a new historical period.

3.1.5. High-Quality Development of the Kidney Bean Industry (2010–)

The development of the KL kidney bean industry has led to the planting of kidney beans in surrounding counties such as Wuzhai, Shench, Ningwu, Lanxian, etc., with a total area of 13333 hectares of kidney beans. Shanxi Province and Xinzhou City jointly revitalize grains, build a “city of grains”, and help the industrialization of kidney beans. Later, an industrialized business model of “company + cooperative + farm-base + farmer + standardization + brand sales” was formed. In addition, a special kidney bean belt and its production and sales distribution center centered in KL County were formed, as shown in Figure 1.

3.2. Driving Forces for Kidney Bean Development in KL County

The rapid development of kidney beans in terms of the introduction, selection, and breeding of new varieties is due to its adherence to a market demand-oriented strategy, its focus on breeding and retaining good varieties, its construction of technical systems, and the support and cultivation of chain entities. The driving force can be summarized as the following four aspects.

Figure 1. Five different stages of kidney bean development in KL County.
3.2.1. A Market-Demand-Oriented Breeding Strategy

The introduction and breeding of KL kidney bean varieties are market-oriented, which entails a complete consideration of the market demand and industrialization efforts for future variety breeding. As shown in Table 3, the focus on the breeding of kidney bean varieties changed from an intense color and large seeds in 1991 to a high yield and strong disease resistance in 2014, and the market demand for protein is still increasing [33]. Concentration and a stronger preference for certain shapes of kidney beans have led to a shift in the structure of kidney beans towards flatter, protein-rich kidney beans. This market orientation should be combined with better breeding and variety selection.

Table 3. Stages of the evolution of kidney bean varieties.

<table>
<thead>
<tr>
<th>Kidney Bean Varieties</th>
<th>Introduction, Breeding, Popularizing Time</th>
<th>Main Advantages</th>
<th>Planting Area (he)</th>
<th>Market-Oriented</th>
<th>Promoting Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>British red kidney beans</td>
<td>1989-1991</td>
<td>Large, brightly colored seeds</td>
<td>53,333.3</td>
<td>Yes</td>
<td>1,2</td>
</tr>
<tr>
<td>Pinjinyun No. 3</td>
<td>2014-2014</td>
<td>High yield, good disease resistance, large and colorful</td>
<td>26,666.7</td>
<td>Yes</td>
<td>1</td>
</tr>
<tr>
<td>Pinjinyun No. 4</td>
<td>2021-2021</td>
<td>Large and flat, high yield, high protein content</td>
<td>3333.3</td>
<td>Yes</td>
<td>1, 3, 4</td>
</tr>
</tbody>
</table>

Note: Market-oriented refers to varieties that meet market demands and the requirements of enterprises and farmers in their production and processing processes. 1: Shanxi Academy of Agricultural Science; 2: Shanxi Grain, Cooking Oil and Foodstuffs Import and Export Corporation; 3: Shanxi Agricultural University; 4: Shanxi Xinfengsheng Agricultural Science and Technology Co., Ltd.

3.2.2. Strong Policy Support for Kidney Bean Science and Technology Innovations

To attain a contiguous link between scientific research and market demand, close cooperation between research institutions, local governments, and farmers is important. In KL, a scientific research planting base has been established in cooperation with Shanxi Agricultural University, the Provincial Academy of Agricultural Sciences, and Northwest Agriculture and Forestry University, which is a well-known agricultural university in the region. These efforts have ensured that the breeding, field demonstration, and promotion of new kidney bean varieties in this region are at the forefront of the region. In addition, they can also be the main guide for farmers’ production and market demand issues, helping them to break through the bottleneck of kidney bean cultivation.

In addition, this study has observed increasing investments in research and the improvement of the establishment of breeding technology systems. KL County has invested significant sums (about 190,000 yuan per year) to demonstrate and promote improved kidney bean varieties. Furthermore, an annual increase of one million yuan in science and technology funding has been used to formulate and promote standardized production technology solutions between large farms and small farmers. Table 4 demonstrates that these funds have effectively promoted the construction of kidney bean demonstration parks, pollution-free standardized production bases, and export bases. In 2017, the county government established a green high-yield kidney bean creation and research and development project, integrating social funds of three million yuan to build a high-yield demonstration base covering an area of 2000 hectares. In order to strengthen on-the-spot technology promotion, KL County has set up a grass-roots agricultural technology promotion project, investing 700,000 yuan each year to support technical instructors stationed in villages and small farms.

3.2.3. Enhancing Supply Chains and Breeding/Reproduction Services

KL County focuses on supporting research institutes, associated businesses, farmers’ cooperatives, technical services, farmers, and other legal entities to collaborate in this field. Table 5 shows that together, a company + cooperative + scientific research base + farmer(s) + standardized industrial management model has been formed to realize the integrated development of kidney bean breeding, promotion, and on-site service. Research institutes
play a key role in the selection and breeding of new varieties. In addition to focusing on research and technical services, they support businesses, cooperatives, and farmers by distributing high-quality seeds and providing training in kidney bean techniques and field instruction. Businesses are a core element of this integrated development path. They maximize the role of other market players and stakeholders and facilitate the allocation of seed industry resources, talent, and capital. Furthermore, to achieve sustainable production and promotion of high-quality varieties, enterprises will become a new force in the innovation of the seed industry. Cooperatives and farmers continue to make efforts to demonstrate, promote, and standardize planting systems to ensure that the excellent traits of kidney beans are transformed into products that meet market demand. KL County fully integrates the “breeding-reproduction-promotion-service” chain of the kidney bean industry, with seeds as the core, seed breeding as the link, and commodity transformation, sales and processing, and other associated services as the terminal.

Table 4. List of funded projects in the study area.

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Description</th>
<th>Funding (1000 Yuan)</th>
<th>Covered Area (Hectare)</th>
<th>Period</th>
<th>Links Involved in the Seed Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demonstration and standardization projects</td>
<td>Construction of a red kidney bean demonstration park, pollution-free standardized production base, and export base</td>
<td>1000</td>
<td>Nationwide</td>
<td>Annually</td>
<td>Variety testing, promotion, and demonstration</td>
</tr>
<tr>
<td>Kidney bean varieties promotion project</td>
<td>Promotion of superior seeds and construction base of red kidney beans</td>
<td>190</td>
<td>Nationwide</td>
<td>Annually</td>
<td>Promotion and demonstration</td>
</tr>
<tr>
<td>Eco-friendly and high-yield red kidney beans creation project</td>
<td>Creation of high-yield demonstration base</td>
<td>3000</td>
<td>2000 hectare</td>
<td>2017</td>
<td>Promotion and demonstration</td>
</tr>
<tr>
<td>Grassroots agricultural technology promotion subsidy project</td>
<td>Grants for technical instructors in the promotion of superior seeds and village visits</td>
<td>700</td>
<td>Nationwide</td>
<td>Annually</td>
<td>Guidance, promotion, and demonstration in the planting link</td>
</tr>
</tbody>
</table>

Note: Collected and Summarized from local government working reports.

Table 5. The role of related entities in the red kidney bean chain.

<table>
<thead>
<tr>
<th>Entities</th>
<th>Role to Play</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific research institutions</td>
<td>Varieties selection and breeding ★★★★★</td>
</tr>
<tr>
<td></td>
<td>Reproduction ★★★★</td>
</tr>
<tr>
<td></td>
<td>Services ★★★</td>
</tr>
<tr>
<td></td>
<td>Popularizing ★</td>
</tr>
<tr>
<td>Field enterprises</td>
<td>Reproduction ★★★★</td>
</tr>
<tr>
<td></td>
<td>Popularizing ★★★★</td>
</tr>
<tr>
<td></td>
<td>Services ★★</td>
</tr>
<tr>
<td></td>
<td>Varieties selection and breeding ★</td>
</tr>
<tr>
<td>Cooperatives</td>
<td>Demonstration ★★★★</td>
</tr>
<tr>
<td></td>
<td>Popularizing ★★★</td>
</tr>
<tr>
<td>Technical service personnel</td>
<td>Services ★★★★</td>
</tr>
<tr>
<td>Farmers</td>
<td>Standardized planting ★★★★</td>
</tr>
<tr>
<td></td>
<td>Demonstration ★★</td>
</tr>
</tbody>
</table>

Note: The total amount stars, a maximum of five, represents a role’s effectiveness. Using the expert scoring method, we asked national and local researchers and agricultural extension workers to rate the roles of different entities. A total of 15 experts were surveyed. The optimal score is five out of five. The results in Table 4 are the average of the results scored by 15 experts.

3.2.4. Transforming Advantages into Brand Building and Standardization

The KL county government has announced several policies to establish the kidney bean sector as the leading local industry. In 2006, the government issued a basic policy
for the year entitled “Opinions on Accelerating the Construction of High-quality Grain Industrial Zones in the County”. In 2007, the “Regional Layout Plan for Advantageous Agricultural Products” was compiled. Since 2011, kidney beans have been included in the “One Village One Product” project. As a pillar industry of agricultural development, the county proposes to develop the small grain industry with kidney beans as the mainstay and strives to build “the first county of kidney beans in China”. Standards were then developed concerning kidney beans. These efforts led to the development of the “KL County Standardized Kidney Bean Planting Procedure” and the “KL County Standard for Kidney Bean Acquisition and Grading” to guide the production and cultivation of kidney beans. The local government further provides different forms of support to the demonstration areas and standardized bases to ensure that the nutritional composition, size, and color of kidney beans meet the standards, and the local government also lays the foundation for subsequent standardized processing and sales. Therefore, this process has standardized the entire industrial chain of kidney beans Figure 2 and has developed a good foundation for future brand promotion.

![Figure 2. Mechanism of the kidney beans' industrial development.](image)

3.3. The Contribution of the Kidney Beans Industry to the Local Development of KL County

3.3.1. Increased Farmers’ Income and Greatly Reduced Poverty

The average annual output value of the whole industry chain (production, processing, and sales) of red kidney beans in Bali County is 150 million yuan. Its red kidney bean planting industry accounts for more than 50% of the county’s total agricultural output value. The per capita net income of kidney bean growers increased from 900 yuan in 2002 to 7432 yuan in 2020, which is an eightfold increase. The per capita net income of kidney bean growers is 1.2 times that of farmers in KL County. The profitability of kidney beans continues to grow, and the average selling price in 2020 rose from 7 yuan/kg in 2018 to about 9 yuan/kg, an increase of 2 yuan/kg, or 28.57%. Excluding farmer-discounted housework-workers, the average profit per hectare in 2020 was 8316.60 yuan, an increase of 1918.05 yuan or 30% from 6398.55 yuan in 2018. These increased profits stem from the maximal use and connection of leading kidney bean enterprises, cooperatives, and poor households. This “enterprise + cooperative + poor household” model strengthens the connection with poverty-stricken households and helps to increase the income of poor households. As of 2020, 37 special grain planting bases (or parks), mainly kidney beans, have been established. This helped drive the planting area of kidney beans to 6666.7 hectares, covering 141 administrative vil-
lages (including 90 poverty-stricken villages), effectively promoting the continued income growth of poverty-stricken households and poverty alleviation in KL County.

3.3.2. Forming a Sound Supply Chain and Industrial Agglomeration Effect

KL County strives to build relationships with businesses and service providers in the kidney bean industry. The county supports 6 leading enterprises, 37 farmers' professional cooperatives, more than 200 brokers, and more than 80 home appliance merchants. The leading enterprises are engaged in the cultivation, production, processing, acquisition, transportation, packaging, and sales. Together, they contribute to the industrialization development pattern within the industry chain. Kidney beans in KL County have produced an industrial agglomeration effect, driving the cultivation of 13,333.3 hectares of kidney beans in the surrounding Wuzhai County, Shenchi County, Lan County, and other places. As a result, a special kidney bean industry belt has been formed, which has led to the rise of red kidney bean production and sales distribution centers in Shanxi Province centered on KL County.

3.3.3. Creating a Special Local Brand and Digging its Brand Value

The local planting of kidney beans has obvious brand advantages due to the local emphasis on the selection and maintenance of varieties with excellent traits and the establishment of a long-term industrial system. The county’s kidney beans and other products have passed the “three products and one standard” certification, which is a collective name for pollution-free agricultural products, green food, organic agricultural products, and the geographical indications of agricultural products. However, one agricultural product with the geographical indication, “KL kidney bean” scores one as a pollution-free agricultural product, four as green food, and one as an organic agricultural product. In addition, in 2010, KL County was awarded the “First County of Chinese Kidney Beans” granted by the China National Association of Grain Sector. In 2012, the county was awarded the certificate and title of “National Quality and Safety Demonstration Zone for Exporting Red Kidney Beans” by the General Administration of Quality Supervision, Inspection, and Quarantine of the People’s Republic of China. In 2013, “KL Red Kidney Bean” was recognized as a National Geographical Indication Product. Also benefiting from the brand value are primary products such as red kidney beans, multigrain kidney beans, and canned red kidney beans, all of which are exempt from export inspection.

3.3.4. Shaping Ecological Effects towards Sustainable Agricultural Development

The production of Kidney beans makes a significant contribution to the sustainable development of the local agriculture sector. According to this survey’s data for KL County from 2019 to 2020, the fertilizer usage of kidney beans in the county is about 1740 yuan per hectare, which is lower than that of rice, wheat, and corn. Specifically, it is 300 yuan/ha lower than rice, 574.5 yuan/ha lower than wheat, and 352.8 yuan/ha lower than corn. In 2020, the number of pesticides used in kidney beans in the county was about 139.8 yuan per hectare, which is significantly lower than that of rice, wheat, and corn. Particularly, it is 772.05 yuan per hectare lower than rice, 282.15 yuan per hectare lower than wheat, and 153.3 yuan per hectare lower than corn. The local promotion of organic farming reduces the impact of fertilizers and pesticides and their carbon footprints. As a legume crop, kidney beans have a well-developed root system that absorbs calcium from deep soil. Mixed seeding between kidney beans and grasses aids in the formation of soil agglomeration structures. Kidney beans have root nodules that collect free nitrogen from the air as nutrients. They have the functions of collecting nitrogen and cultivating land, helping to maintain and improve the quality of farmland, and are an irreplaceable and important part of China’s agricultural planting system. In addition, it is a significant regulator crop that can mitigate the impact of climate disasters on agricultural production.
4. Discussion and Conclusions

The supervision and development of domestic and foreign agricultural varieties have made significant contributions to the local agricultural industry development. China is the largest producer of beans, and kidney beans are an important part of this production. KL County, Shanxi Province, is one of the main production areas for producing high-yield and high-quality kidney beans. In addition, it is a major exporter of Chinese kidney beans. KL kidney beans are an example of a successful transformation of KL’s agricultural sector. Local industries have been nurtured through extensive varietal introduction, selection, and breeding efforts. KL can serve as a reference for the rest of China and many other developing countries. This study uses a qualitative case study approach that has been widely used to study other developing countries. However, few studies have used this method to examine Chinese cases. The advantage of this approach is to determine the general patterns and essential characteristics of each case through detailed, systematic case reports, and to conduct multidimensional research on data from different stakeholders.

This study also revealed the following findings. The first concerns the introduction and continuous improvement of kidney bean varieties in KL County, which has gone through five stages: the first stage, with flax and sunflower as the main industries; the second stage of experimental exploration and cultivation; the third stage of the stable development of the industry; and the fifth stage of high-quality development. The introduction and improvement of varieties also reflect the continuous development and growth of the red kidney bean industry in KL County. The second finding concerns the current situation of red kidney bean introduction, which is the result of the joint efforts of the government, scientific research institutions, enterprises, cooperatives, and farmers, together with the use of excellent varieties and the support for the construction of technical systems and the cultivation of chain entities. In addition, industrial integration and brand building have also significantly promoted the development of the kidney bean industry. Third, the kidney bean industry has promoted local development in four aspects: by increasing farmers' income, which has a great impact on industrial poverty alleviation; by forming a relatively complete red kidney bean industry chain, which has produced an industrial agglomeration effect; by focusing on cultivating kidney bean varieties and creating unique distinctive local brands further create brand value; and by enabling remarkable ecological effects, which effectively promote the green and sustainable development of the county.

Finally, this study demonstrates that as food prices and labor costs have risen in recent years, farmers are still choosing between growing kidney beans and undertaking other farm work. It is necessary to further extend the industrial chain, enhance the brand, stimulate the industrial value, and give full play to the role of kidney beans towards increasing farmers’ income and poverty alleviation. At present, the disease resistance of kidney bean varieties is still relatively weak. In addition, the mechanization level in the growing areas remains low and is often hit by extreme weather. Therefore, there is a need for the selection of varieties with improved disease resistance and efforts to achieve mechanized adaptation. This can be designed and implemented by the government and research institutes. In the future, when choosing a breeding route, we should pay close attention to market price changes and dynamic changes in consumer demand trends, because they are closely related to the marketing system.

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