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# Analysis of Farmers' Behavior in Purchasing Wheat Seed Varieties and Its Influencing Factors—Based on A Survey Conducted in Gaomi

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## Abstract

Seeds are often referred to as the "chips" of agriculture, which form the essential foundation for farmers' production activities. In recent years, the Chinese government has launched the "Seed Industry Revitalization Initiative", providing comprehensive policy support for the sector's growth. However, as the seed market continues to expand, wheat farmers now face increasing challenges in selecting varieties due to the growing number of options available. Drawing from a survey of farmers in Gaomi City, this study delves into the intricacies of farmers' purchasing decisions for wheat seed varieties. Research indicates that characteristics of wheat seed variety, policy environment, seed registration and market price significantly influence wheat seed variety selection in Gaomi City. Based on these findings, this paper proposes four key recommendations: 1) Implement stratified and categorized training to establish exemplary models; 2) Encourage farmers to adopt moderate-scale operations; 3) Enhance variety awareness and promote diversified dissemination channels; 4) Optimize government policies to strengthen policy effectiveness.

## Keywords

Wheat Seed Varieties, Farmers, Behavior in Seed Purchasing, Influencing Factors

## 1. Introduction

### 1.1. Research Background

With 733 million people facing hunger globally in 2023, as reported by the United Nations Food and Agriculture Organization, it is clear that food security is not

just fundamental but a critical component for ensuring the well-being of individuals, maintaining social stability, and fostering the long-term peace and prosperity of the nation. Food security stands as a critical pillar of national security, underpinning the country's ability to sustain its population and safeguard its strategic interests. Ensuring the safe supply of grains and important agricultural products has always been a cornerstone of China's national security strategy, as evidenced by the consistent growth in grain production and the implementation of policies that prioritize food security. China, with its population exceeding 1.4 billion, is persistently vigilant in addressing the ongoing challenge of ensuring national food security. This vigilance is crucial given the impact of urbanization on rural areas and the need for innovative agricultural technologies and supportive policies to sustain food production.

Grain is the foundation of the state, and the seed industry is the cornerstone of grain production. From a legal perspective, the "Food Security Law of the People's Republic of China" clearly states that to ensure grain production, the state must promote the revitalization of the seed industry, safeguard seed industry security, and drive high-quality development in the seed sector. The seed industry, underpinned by technological advancements and innovation, is the cornerstone of agricultural development and grain production, ensuring the sustainability and resilience of farming systems. As a major agricultural producer and seed consumer, China regards the seed industry as a strategic and foundational core industry, tasked with ensuring the security of China's "rice bag", and serving as a crucial foundation for developing modern agriculture and safeguarding national food security. From a policy perspective, from the "12th Five-Year Plan" to the "14th Five-Year Plan", national policies have consistently prioritized the vigorous development of the seed industry, promoting innovation and industrial application in biological breeding, establishing breeding bases, and enhancing the international competitiveness of seed enterprises. The "Plan for Accelerating the Construction of a Strong Agricultural Nation (2024-2035)" proposes to achieve comprehensive breakthroughs in independent innovation in the seed industry. The Central Document No.1 has repeatedly emphasized the importance of the seed industry, proposing in 2023 to thoroughly carry out the seed industry revitalization action, which has achieved significant progress, including the completion of the national agricultural germplasm resources census and breakthroughs in agricultural machinery equipment with shortcomings. In 2024, the document further emphasized accelerating the seed industry revitalization action, improving joint research and application collaboration mechanisms, and intensifying efforts to breed and promote independent and excellent varieties, as well as strengthening intellectual property protection for the seed industry. The government is committed to accelerating the selection and promotion of high-quality indigenous crop varieties, making efforts to overcome key core technologies in seed sources, as evidenced by the initiatives in Heilongjiang Province and the city-level action plans, to ensure stable and safe supply of essential agricultural products. Imple-

menting integrated pilot projects for the research and the development, application and promotion of major agricultural varieties, along with the industrialization and expansion of biological breeding; in 2025, it further stressed the full implementation of the seed industry revitalization action, harnessing the power of major agricultural research platforms like the "Nanfan Silicon Valley" to accelerate the breakthrough of a series of innovative varieties.

Wheat, as the second-largest grain crop in the world, is a staple food in many countries and plays a crucial role in global food security. As a staple food crop in China, wheat significantly contributes to global wheat production, with China's share estimated at 17.6%. This positions China as the world's largest wheat producer, playing a crucial role in ensuring food security and social stability. China's wheat production has been growing, even as planting areas have decreased, due to advancements in cultivation techniques and facilities. For instance, in 2022, China's wheat production reached 137.72 million tons, marking a 0.6% increase from the previous year. Moreover, China's wheat production has been consistently leading globally, with its share being the highest among major producing countries. Wheat cultivation is widespread across the country, with major production areas covering provinces such as Hebei, Shanxi, Henan, Shandong, Anhui, Hubei, Jiangsu, Sichuan, and Shaanxi, serving as the staple. According to the Ministry of Agriculture, Henan, Shandong, and Anhui are the top wheat-producing provinces in China, significantly contributing to the national wheat production, with Henan leading the way. In 2023, wheat production was predominantly concentrated in the Huanghuai and North China regions, which together accounted for approximately 79.66% of the total national wheat planting area. It serves as food for residents in many regions, especially in the northern areas. "A nation is rooted in agriculture, and agriculture is prioritized by seeds", highlighting the pivotal role of the seed industry in the agricultural sector. China has made significant strides in wheat breeding, with notable advancements in yield, quality, and disease resistance, as evidenced by the successful development of self-sufficient wheat varieties. The integration of cutting-edge technologies such as computer science, IoT, big data, AI, and biotechnology has further propelled the industry forward. Seed companies have expanded in scale, and the market has experienced continuous growth, reflecting the robust development of China's wheat seed sector. Meanwhile, China's seed industry boasts robust research capabilities and a diverse array of crop resources, supported by specialized institutions focused on crop breeding and improvement, resulting in the development of a substantial number of crop varieties. However, wheat varieties face challenges related to diversity, disorder, and complexity, and the selection of these varieties directly impacts wheat yield and economic benefits, agricultural productivity, and farmers' income. The choice of wheat varieties by farmers is influenced by various factors. As the primary decision-makers in technology selection, farmers represent the "last mile" in the transformation of agricultural scientific achievements and are the critical link in determining whether wheat varieties can be efficiently trans-

lated into tangible productivity (Chen, 2016). Hence, this study commences with farmers' purchase of wheat varieties as a focal point, exploring the characteristics of their wheat seed purchasing behavior and proposing relevant policy recommendations grounded in this analysis.

## 1.2. Literature Review

Scholars focus on the behavior of farmers in purchasing crop seed varieties and the multifaceted factors influencing their decisions, including adaptability to local conditions, resistance to adverse environmental factors, yield potential, and seed quality.

### 1.2.1. Research on Different Crop Varieties

Scholars globally have carried out extensive research on farmers' behavior in seed purchase regarding different crop varieties. Barkley & Porter (1996) analyzed farmers' wheat seed variety choices and identified production characteristics and inherent quality as key influencing factors. Regarding rice, Chandio & Jiang (2018) demonstrated that for small farmers in Pakistan, agricultural experience, soil quality, education level, and market information have a significant influence on the adoption of improved rice varieties. Digal & Placencia (2020) explored the adoption of hybrid and high-yield rice varieties by Filipino farmers, identifying factors that influence their uptake. This research aligns with the broader context of the Philippines' efforts to improve rice self-sufficiency, as evidenced by historical and contemporary studies on hybrid rice development and challenges in the country. With corn cultivated in over 170 countries and regions, Numerous studies have examined corn variety selection. Doss (2001) found that gender factors significantly influence farmers' choices of corn varieties, as evidenced by research on hormonal regulation in corn sex determination and farmers' behavior when selecting new corn varieties. Dreisigacker et al. (2019) carried out a study on the selection of drought-resistant corn varieties among Ugandan farmers, which revealed that variety pricing, farmers' awareness of varieties, and their purchasing patterns all, to some extent, influence their selection behavior.

Research by Chinese scholars on farmers' behavior in seed purchase has primarily centered on crop cultivation. Specifically, studies by Li (2019) and Wei (2023) have highlighted the importance of seed availability and risk tolerance in the selection of wheat varieties by farmers in the Huang-Huai-Hai region and Henan Province. Xu (2022) demonstrated that educational attainment and farming scale substantially affect corn variety selection. Ma Yue (2021b) identified multiple factors, including educational background and awareness of recommended new varieties, influencing millet growers' choices. Jin & Liu (2012) and Yang et al. (2015) uncovered both internal and external factors affecting soybean growers' variety selection. Zhao et al. (2020) clarified key determinants for new sorghum variety selection in brewing. Recent advancements in cash crop research encompass analyses by Liu & Shi (2022) and Shi (2024), focused on medicinal herb cultivation intentions and forestry medicine variety selection behaviors, along with

the identification of pertinent influencing factors.

#### 1.2.2. Influencing Factors of Farmers' Behavior in Purchasing Seed Variety

As the primary participants in agricultural production, farmers tend to choose crop varieties that most benefit their operations when seeking maximum efficiency. Various factors influence farmers' decision-making behaviors, prompting scholars worldwide to analyze the determinants of these choices. Notable studies include: David et al. (2002) examined variety selection among legume growers, concluding that effective seed supply significantly impacts farmers' adoption of new varieties. Barrera et al. (2005) investigated potato cultivation, demonstrating that planting returns are crucial in motivating farmers to continue growing potatoes. Karim et al. (2014) conducted an in-depth study on shrimp farming technology adoption in Bangladesh, identifying training opportunities and farmers' age as key influencing factors.

Chinese scholars have concentrated on both internal and external factors in their research. Zhang (2023) conducted a multi-group comparative analysis of cotton farmers in Xinjiang, investigating how age, gender, and educational level influence their variety selection behaviors. Ma (2022) surveyed vegetable growers in Hebei Province and analyzed the collected data, concluding that gender had no significant impact on growers' adoption of vegetable varieties. Meanwhile, age, education level, and personal experience demonstrated significant influence. Liao (2018) employed status analysis, theoretical interpretation, and empirical model testing to investigate the determinants of herd behavior in seed purchasing. He considered factors such as price sensitivity, brand loyalty, and quality consciousness, which significantly influence farmers' timing decisions. Zhou et al. (2013) analyzed survey data from farmers across 19 provinces nationwide, revealing that selected varieties and seed quality significantly affect peanut growers' technical efficiency and final yields. Zhu et al. (2019) found that disease-resistant new varieties show differential preferences among banana farmers, with those demonstrating significant advantages ultimately gaining their favor. Li (2022) demonstrated that soil environment and geographical location factors have a significant positive impact on farmers' adoption of new potato varieties. Gao (2024) conducted a study using survey data and multiple econometric models and revealed that learning exchanges, network reciprocity, authority and prestige, and online trust among large-scale farmers and smallholders significantly influence their adoption of new forage varieties. Notably, the social network influence factor showed greater impact on large-scale farmers than smallholders, providing targeted policy recommendations to enhance adoption rates of new varieties or technologies in China. Liu et al. (2018) found that government subsidies are pivotal in incentivizing farmers to adopt the Yugu 18 new variety, as evidenced by various studies that highlight the positive impact of subsidy policies on farmers' decisions to embrace new agricultural technologies. Ma (2021a) analyzed survey data from 917 grain farmers across four prov-

inces (Henan, Shandong, Heilongjiang, and Shanxi), concluding that production material prices, grain planting subsidies, participation in technical training, and government investment in grain production all positively affect farmers' enthusiasm for grain cultivation.

#### 1.2.3. Review

Scholars have adopted diverse crop types as research subjects, including staple crops such as rice, corn, wheat, millet, soybeans, and sorghum, cash crops like medicinal herbs and vegetables, as well as various aquaculture species. The review of existing research indicates that farmers' crop variety selection behavior, influenced by market information asymmetry, the adaptability of new varieties, and considerations of planting costs, constitutes a pivotal issue closely related to agricultural product quality, farmers' income growth, and production efficiency. These studies have explored individual characteristics, household factors, production patterns, farmers' awareness levels, and external policies. Notably, farmers across different regions exhibit significant variations in variety selection behaviors. Focusing on Gaomi City as a specific case study, this paper conducts an in-depth analysis of local farmers' wheat seed variety selection behaviors and their influencing factors.

## 2. Analysis of Farmers' Behavior in Purchasing Wheat Seed Varieties in Gaomi City

This study examines farmers' wheat seed purchase behavior by analyzing their demographic characteristics, land resources, production conditions, knowledge of seed varieties, and external policy environments. It offers evidence-based recommendations to farmers and seed producers for optimizing their choices. The research aims to stabilize and enhance wheat yields in Gaomi City, thereby increasing farmers' incomes and promoting sustainable agricultural development.

### 2.1. Overview of the Sample

Shandong Province, situated in the eastern coastal area of China, along the middle and lower reaches of the Yellow River, enjoys advantageous geographical conditions and abundant natural resources, with a solid agricultural foundation. The province boasts extensive wheat cultivation areas, and the wheat industry plays an irreplaceable role in ensuring national food security, promoting farmers' income growth, and driving agricultural technological innovation. Gaomi City, a county-level municipality under Weifang City in Shandong Province, primarily grows wheat as its main summer grain crop and serves as a crucial wheat production base in the Jiaodong region. Its wheat cultivation also plays a significant role in the regional agricultural economy and national food security. This study focuses on Gaomi City in Shandong Province, using household groups as research subjects.

A randomized sampling survey was conducted among farmers within the study area, collecting data through paper questionnaires, digital surveys distributed via

WeChat and other social media platforms, and on-site interviews. The survey was conducted from March to April, 2025, with 150 questionnaires distributed and 116 returned, achieving a 77.3% response rate. After excluding incomplete responses, clearly erroneous data, and those omitting critical information, 105 valid questionnaires remained, yielding a 70% validity rate. The sample covered areas included Liquan Sub-district, Baicheng Town, Damujia Town, Jiangzhuang Town, and Jiaohe Community in Gaomi City (see Table 1).

Table 1. Distribution of surveyed areas and farmers.

| Surveyed areas | Number of farmers surveyed | Number of farmers interviewed |
|---|---|---|
| Liquan Street | 5 | 26 |
| Baicheng Town | 4 | 24 |
| Damaojia Town | 3 | 22 |
| Jiangzhuang Town | 3 | 15 |
| Jiehe Community | 2 | 12 |
| Other areas | 2 | 6 |
| Total | 19 | 105 |

## 2.2. Demographic Characteristics of Farmers Surveyed

### 2.2.1. Farmers' Age

The majority of wheat farmers are aged 41 and above, accounting for 62.8% of the total. Survey data reveals: 10 farmers (9.5%) are under 30; 29 (27.6%) are aged 31 - 40; 34 (32.4%) are in the 41 - 50 age bracket (the largest group); 19% are aged 51 - 60; and the remaining 12 farmers (11.4%) are over 60 (see Table 2). Data indicates that the cultivation of wheat is predominantly undertaken by middle-aged and elderly farmers, who contribute their extensive experience and align with the agricultural realities of China. Although younger participants are still scarce, there is a discernible trend of enhancing youth participation. Gaomi City's initiatives, such as "Leading Geese Navigation" and "Returning Geese Recruitment", have successfully attracted young entrepreneurs to return to rural areas. Looking ahead, the proportion of young talent in wheat farming is anticipated to increase steadily.

Table 2. Age distribution of surveyed farmers.

| Age | Frequency | Percentage (%) |
|---|---|---|
| Under 30 | 10 | 9.5 |
| 31 - 40 | 29 | 27.6 |
| 41 - 50 | 34 | 32.4 |
| 51 - 60 | 20 | 19 |
| 60 and above | 12 | 11.4 |
| Total | 105 | 100 |

### 2.2.2. Farmers' Educational Background

The educational background of the farmers is as follows: 11 individuals (10.5% of the total) are uneducated, 43 (41%) have completed primary education, another 43 (41%) have completed junior high school, 5 (4.8%) have completed high school or vocational education, and 3 (2.9%) have attained college-level or higher education (see Table 3). This indicates that most wheat-growing households have relatively low educational attainment, with the majority having only received compulsory education.

Table 3. The educational background of surveyed farmers.

| Educational background | Frequency | Percentage (%) |
|---|---|---|
| Uneducated | 11 | 10.5 |
| Primary school education | 43 | 41 |
| Junior high school education | 43 | 41 |
| High school or vocational education | 5 | 4.8 |
| College-level or higher education | 3 | 2.9 |
| Total | 105 | 100 |

### 2.2.3. Social Connections

Among wheat farmers, 80 households have relatives or friends serving as village cadres. These farmers typically acquire crucial information from village cadres, encompassing details on wheat varieties and subsidy policies, and generally place their trust in them. Additionally, 58 agricultural demonstration households cultivate various high-quality wheat varieties in their fields, allowing other farmers to observe their growth patterns and disease/pest resistance firsthand.

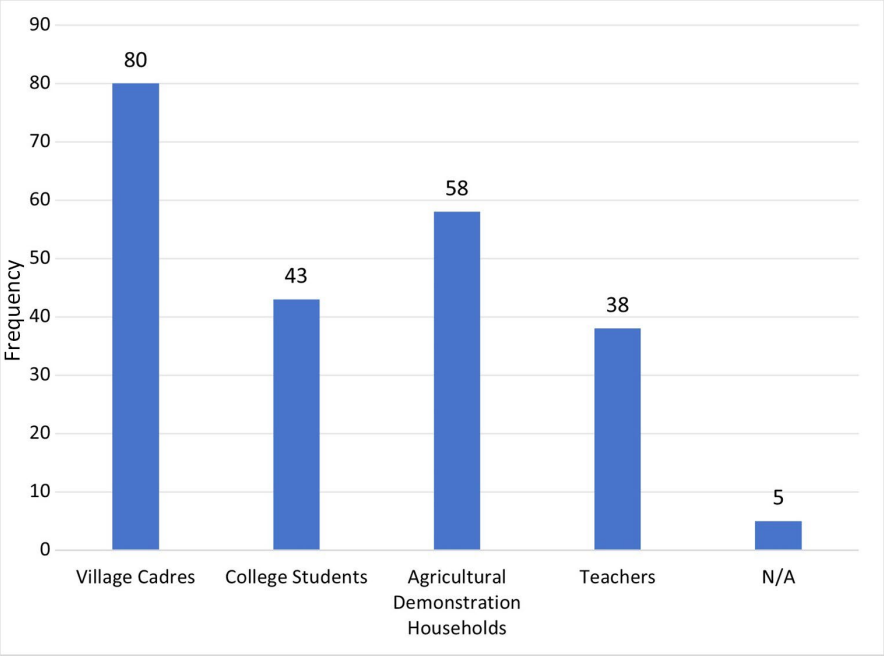


Figure 1. Social connections of farms surveyed.

This approach leaves a profound impression and yields a positive impact. Moreover, 43 college students and 38 teachers are involved, and they generally possess strong capabilities in accessing and disseminating information. They frequently collect agricultural information via online resources and share it with farmers (see Figure 1).

## 2.3. Farmers' Production and Operations

### 2.3.1. Planting Areas

The wheat planting areas in Gaomi City are primarily small-scale. Among the surveyed farmers, 93 households have wheat planting areas under 20 mu, accounting for 88.6%; while 12 households have a wheat planting area exceeding 20 mu, representing 11.4% of the total surveyed farmers (see Table 4).

Table 4. Cultivated land areas.

| Land area (mu[1]) | Frequency | Percentage (%) |
|---|---|---|
| Within 5 mu | 35 | 33.3 |
| 5 to 10 mu | 32 | 30.5 |
| 11 to 20 mu | 26 | 24.8 |
| 21 to 50 mu | 8 | 7.6 |
| Over 50 mu | 4 | 3.8 |
| amount to | 105 | 100 |

### 2.3.2. Number of Laborers

The most common household structure for wheat cultivation consists of two workers, with 36 households (34.3%) adopting this configuration. The second most prevalent household structure involves one worker, accounting for 32.4% of the surveyed households. Among all households, 26 households (24.8%) have three workers. According to the survey, only 9 (8.6%) employ four or more workers, reflecting a generally low workforce participation rate in wheat farming, as indicated by Table 5. Most laborers likely migrate to urban areas for non-agricultural employment. Notably, large-scale wheat growers typically demonstrate higher labor involvement in wheat cultivation.

Table 5. Number of laborers engaged in wheat cultivation.

| Number of laborers | Frequency | Percentage (%) |
|---|---|---|
| 1 | 34 | 32.4 |
| 2 | 36 | 34.3 |
| 3 | 26 | 24.8 |
| 4 or more | 9 | 8.6 |
| Total | 105 | 100 |

[1]It is a Chinese unit of land area, 1 mu is equal to approximately 666.7 square meters.

### 2.3.3. Specialization

Among wheat farmers, a significant proportion engage in part-time farming, while those primarily focused on full-time wheat cultivation constitute a smaller group. Specifically, 63% of farmers engage in occupations other than farming, while the remaining 37% focus fully on wheat cultivation (see Figure 2). This practice is prevalent, as some farmers, constrained by limited land availability or low wheat yields, concurrently cultivate other cash crops or undertake supplementary activities alongside wheat production.

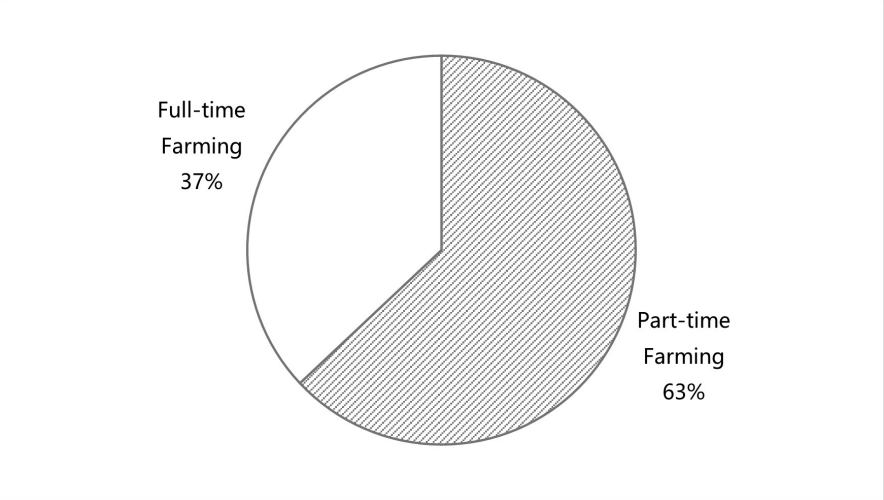


Figure 2. Specialization of farmers surveyed.

### 2.3.4. Income Generated from Wheat Cultivation

The annual income of farmers growing wheat is influenced by multiple factors, including seed quality, fertilizer, pesticide, irrigation, mechanization, labor costs, government subsidies, market price fluctuations, planting scale, cultivation methods, and yield. Among the surveyed households, 29 (27.6%) earn less than 20,000 yuan per year from wheat cultivation, while 35 (33.3%) earn between 20,000 and 40,000 yuan. Additionally, 21 households (20%) earn between 40,000 and 60,000 yuan, and 20 households (19%) earn more than 60,000 yuan (see Table 6). Small-scale farmers, who have limited mechanization and weaker risk resistance, typically report lower incomes. Part-time farmers also contribute a relatively small proportion of wheat income to their total household earnings. In contrast, large-scale grain growers and family farms leverage economies of scale, superior crop varieties, advanced agricultural machinery, and modern techniques to effectively reduce production costs and boost profitability.

Table 6. Annual income from wheat cultivation.

| Income (Yuan) | Frequency | Percentage (%) |
|---|---|---|
| Less than 20,000 | 29 | 27.6 |
| 20,000 - 40,000 | 35 | 33.3 |
| 40,000 - 60,000 | 21 | 20 |

Continued

| | | |
|---|---|---|
| 60,000 or more | 20 | 19 |
| Total | 105 | 100 |

## 2.4. Farmers' Cognition of Wheat Varieties

Variety demonstration events serve as a key platform for farmers to learn about wheat varieties. As shown in Table 7, 52 farmers (49.5%) have never participated in such events, indicating that there is significant potential for expanding event coverage among farmers in Gaomi City. Among the participants, 35 farmers (33.3%) took part in 1 - 2 events, suggesting that their level of engagement was limited and that sustaining participation was challenging. Only 18 farmers (17.1%) participated in 3 or more events, reflecting that a small proportion of farmers acquired in-depth knowledge through these activities. The high proportion of non-participants highlights the need for improvements in the organizational model and content of variety demonstration events in Gaomi City.

Farmers' responses to the current wheat seed variety promotion campaign show mixed results. Specifically, 35.2% of farmers expressed strong satisfaction with the new wheat varieties and agricultural practices, while 16.2% reported moderate satisfaction. A significant portion, 34.3% of the farmers (36 individuals), indicated neutral satisfaction. A further 9.5% and 4.8% of farmers indicated dissatisfaction and strong dissatisfaction respectively. These findings suggest that Gaomi City has made certain progress in promoting wheat varieties, yet there remains significant potential for enhancing both the quality and content optimization of the campaign.

Concerning farmers' comprehension of wheat seed variety characteristics, merely 15.2% indicated limited knowledge, whereas 40 farmers, accounting for 38.1%, exhibited a moderate level of awareness. This suggests that the majority of farmers have a foundational understanding of wheat varieties, albeit their comprehension is still somewhat constrained. In particular, 25 farmers, representing 23.8%, displayed a relatively clear grasp of variety traits, and 24 farmers (22.9%) exhibited a notably clear understanding. The data indicate that while farmers possess a broad foundational knowledge of wheat varieties, their depth of understanding remains inadequate, with certain knowledge gaps persisting. Future initiatives should prioritize enhancing public education and training programs to bolster farmers' knowledge of wheat varieties (see Table 7).

The wheat variety system operates under a registration framework. Varieties that are registered typically exhibit superior traits, giving them strong market competitiveness and higher adoption rates among farmers. These varieties are referred to as dominant varieties in this study. According to the survey, the preferred wheat varieties among farmers in Shandong province include Jimai 22, Xinmai 296, and Shannong 27, among others. A cross-analysis of farmers' knowledge of

wheat seed variety traits in Shandong province and their purchase decisions reveals that 76% of those who had a "fairly clear" understanding and 83.3% of those with a "very clear" understanding of these traits opted for recommended varieties (see Table 8). This aligns with farmers' preferences for varieties that exhibit specific traits such as high yield and disease resistance, as evidenced by the popularity of varieties like Jimai 20 and Yannong 19 in Shandong. This indicates that farmers with higher knowledge of variety traits are more likely to purchase recommended varieties.

Table 7. Farmers' cognition of wheat varieties.

| Cognition of wheat varieties | Options | Number of households | Percentage (%) |
|---|---|---|---|
| Participation in the variety demonstration event | 0 times | 52 | 49.5 |
| | 1 - 2 times | 35 | 33.3 |
| | 3 or more times | 18 | 17.1 |
| You are satisfied with product promotion | Strongly Disagree | 5 | 4.8 |
| | Disagree | 10 | 9.5 |
| | Neither agree nor disagree | 36 | 34.3 |
| | Agree | 17 | 16.2 |
| | Strongly agree | 37 | 35.2 |
| You know the characteristics of the variety | Strongly Disagree | 6 | 5.7 |
| | Disagree | 10 | 9.5 |
| | Neither agree nor disagree | 40 | 38.1 |
| | Agree | 25 | 23.8 |
| | Strongly agree | 24 | 22.9 |
| Total | | 105 | 100 |

Table 8. Cross-analysis of the cognition of variety characteristics and farmers' purchasing behavior of dominant wheat varieties.

| You know all the characteristics of the variety. | | Do you want to purchase the dominant variety in this region? | | Total |
|---|---|---|---|---|
| | | No | yes | |
| Strongly disagree | Frequency | 4 | 2 | 6 |
| | Percentage | 66.70% | 33.30% | 100.00% |
| Disagree | Frequency | 7 | 3 | 10 |
| | Percentage | 70.00% | 30.00% | 100.00% |
| Neither agree nor disagree | Frequency | 9 | 31 | 40 |
| | Percentage | 22.50% | 77.50% | 100.00% |
| Agree | Frequency | 6 | 19 | 25 |
| | Percentage | 24.00% | 76.00% | 100.00% |
| Strongly agree | Frequency | 4 | 20 | 24 |
| | Percentage | 16.70% | 83.30% | 100.00% |

## 3. Factors Influencing Farmers' Purchase of Wheat Seed Varieties

### 3.1. General Factors

In the questionnaire, a question was designed to identify all the factors influencing farmers' selection of wheat varieties. In this question, farmers were asked to tick all the applicable factors. Based on the result, when selecting wheat varieties, farmers are influenced by a number of factors. Among the surveyed farmers, 95 opt for varieties based on market prices, while 67 select government-registered varieties. These registered varieties, having seeds that have undergone rigorous regional trials and certifications are typically found to exhibit superior yield and quality, as they are subjected to strict scrutiny and selection processes. They also mitigate trial-and-error risks, ensuring stable returns that incentivize farmers to adopt these options. Another 62 farmers buy wheat seed variety through government seed subsidies, which help reduce costs and enhance purchasing willingness. 61 farmers make decisions based on past planting experience. Long-standing farming practices significantly influence purchasing decisions, as farmers are well-acquainted with the characteristics of previously grown varieties and cultivation techniques. Additionally, 41 farmers opt for varieties recommended by family, friends, and demonstration households, who act as information intermediaries. In rural communities, farmers frequently observe and imitate one another's choices, thereby influencing wheat seed variety selection (see Figure 3).

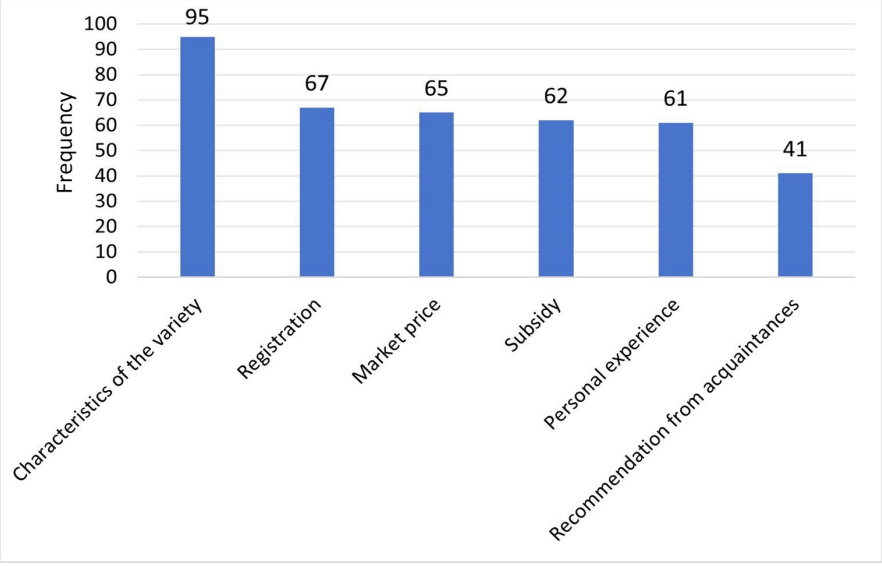


Figure 3. Factors affecting farmers' choice of wheat seed varieties.

### 3.2. Wheat Seed Variety Characteristics

As shown in Figure 3, the characteristics of wheat varieties notably affect farmers' purchasing decisions. Farmers' preferences are further examined, and the results show that high-yield varieties continue to be the top choice for the majority of

wheat growers, with 34 surveyed farmers (32.4%) giving priority to this trait. Farmers choose high-yielding wheat varieties, such as Jimai 22, Aikang 58, Bainong 207, and Zhou-mai 27, to enhance their wheat yields and boost income. Meanwhile, wheat in Gaomi City faces challenges from stripe rust, Fusarium head blight, aphids, and underground pests, posing disease resistance as a primary concern for 27.6% of farmers. To cope with extreme weather like heavy rain and strong winds, Lodging resistance is another frequently emphasized feature, valued by 22.9% of surveyed farmers. Additionally, 18 farmers prioritize high-quality wheat varieties, which are characterized by high protein content, superior gluten quality, and excellent processing characteristics, such as high flour yield and white flour color, providing significant economic benefits for wheat processors (see Table 9).

Table 9. Farmers' preferences for wheat seed variety characteristics.

| Characteristic | Frequency | Percentage (%) | Precedence |
|---|---|---|---|
| High yield | 34 | 32.4 | 1 |
| Lodging-resistant | 24 | 22.9 | 3 |
| Resistance to diseases and pests | 29 | 27.6 | 2 |
| High quality | 18 | 17.1 | 4 |
| Total | 105 | 100 | |

### 3.3. Policy Environment

As shown in previous analysis, variety registration and government subsidy combined have major influence on farmers' wheat seed variety purchase behavior. In recent years, China has been continuously improving its variety registration system. In 2022, the government approved and registered 1560 major crop varieties, with a notable 176 new wheat varieties being introduced, showcasing advancements in crop diversity and quality. The government has introduced a series of subsidies for grain crops, including quality seed subsidies, agricultural machinery purchase and application subsidies, wheat "one spray, three protections" subsidies, farmland rotation and fallow subsidies, and agricultural insurance premiums. Over half of the farmers (51.4%) expressed strong or moderate interest in agricultural policies. Survey data indicate that 31.4% of farmers had an average level of interest in agricultural policies, while 16.2% showed low interest, suggesting that the type of policy support may significantly influence farmers' engagement levels. A substantial majority (65.7%) of farmers surveyed across Shandong, Hebei, and Henan provinces reported that agricultural policies significantly influenced their selection of wheat varieties. Additionally, 20% noted a moderate influence, 10% observed a minimal impact, and a small fraction, comprising 5 farmers (4.8%), deemed the impact negligible (Table 10).

Table 10. Policy environment.

| | Options | Frequency | Percentage (%) |
|---|---|---|---|
| You are concerned with agricultural policies | Strongly Disagree | 6 | 5.7 |
| | Disagree | 11 | 10.5 |
| | Neither agree nor disagree | 33 | 31.4 |
| | Agree | 30 | 28.6 |
| | Strongly agree | 25 | 23.8 |
| You think government policies have a significant impact on your decision-making | Strongly Disagree | 5 | 4.8 |
| | Disagree | 10 | 9.5 |
| | Neither agree nor disagree | 21 | 20 |
| | Agree | 39 | 37.1 |
| | Strongly agree | 30 | 28.6 |
| Total | | 105 | 100 |

## 4. Conclusions and Recommendations

### 4.1. Conclusions

By drawing on the research findings and experiences of other scholars, and incorporating data from 105 surveys conducted in Gaomi City, this paper conducts a descriptive analysis focusing on farmers' individual characteristics, production and management behaviors, as well as their perceptions of wheat varieties, and draws the following conclusions:

The decision-making of farmers in Gaomi City regarding wheat seed variety selection is influenced by multiple factors. Generally speaking, characteristics of wheat varieties, seed registration, market price and subsidy are viewed by farmers as major factors when selecting seed varieties.

Farmers' awareness of wheat varieties is closely linked to the rationality of their purchasing decisions. Currently, some farmers in Gaomi City show significant gaps in their understanding of the characteristics and cultivation of wheat varieties techniques, and market demands. Their restricted access to a variety of information results in incomplete and fragmented knowledge. The constraints imposed by climate change, disease and pest issues, as well as cost pressures, make it challenging for farmers to select the most suitable wheat varieties based on their specific growing conditions and market needs.

Government policies, mainly the registration system and subsidies, serve as crucial external incentives and play a significant guiding role in shaping farmers' seed—purchasing behaviors, thereby fostering a favorable social environment for variety selection. However, Gaomi City currently faces challenges in policy promotion. The insufficient publicity efforts have resulted in farmers having limited awareness of government-recommended dominant varieties and the related subsidy policies. For instance, information about the promotion subsidies for new varieties has not been effectively conveyed to farmers, leading them to abandon

superior varieties due to a lack of policy support. At the same time, farmers' attention to and trust in policies also influence their implementation effectiveness. If farmers do not fully understand policy content or have doubts about its implementation, their enthusiasm for participating in policy-guided activities will decrease. For example, some farmers question government-recommended dominant varieties, refusing to follow these policy recommendations and instead relying on personal experience or acquiring seeds through other means. This not only weakens the guiding role of policies in agricultural production but also impedes the promotion of high-quality wheat varieties and industrial upgrading.

### 4.2. Recommendations

Given that the purchase behavior of wheat varieties among farmers in Gaomi city is influenced by multiple factors, systematic countermeasures and suggestions are proposed from the aspects of optimizing farmers' conditions, improving production and management, enhancing cognitive levels, and strengthening policy guidance.

1) Stratified and categorized training to establish exemplary models

Improving farmers' scientific literacy serves as a crucial strategy for promoting the adoption of high-quality wheat varieties. Tailored training programs should be designed for growers of different age groups and educational backgrounds. Younger farmers can be informed through straightforward explanations of the key characteristics of these varieties, while middle-aged and elderly farmers may participate in trial planting to gain firsthand experience, thereby reducing risk perception and enhancing acceptance of the dominant varieties. Diverse training methods effectively boost farmers' professional skills and scientific decision-making capabilities. Initiatives such as "Model Wheat Growers" and "High-Yield Wheat Competitions" in villages not only acknowledge outstanding farmers but also inspire others through role models. This approach also increases the prominence of dominant wheat varieties, effectively motivating farmers to adopt them.

2) Encouraging farmers to engage in large-scale operations

Moderate-scale farming practices among smallholders significantly enhance wheat seed variety selection. Via land transfer policies, we motivate small farmers to merge their land with large-scale growers and family farms. This consolidation broadens wheat cultivation and advances sustainable agricultural practices. operations. Additionally, by setting up land trusteeship service organizations and leveraging the expertise of agricultural cooperatives, customized services can be provided to farmers facing challenges in expanding their operations, thereby effectively mitigating risks associated with crop variety selection due to fragmented farming.

3) Raising awareness of varieties and promoting them through multiple channels

To bolster experimental demonstration efforts, county-level wheat seed variety demonstration bases should be well established, showcasing the yield, quality, and

disease resistance characteristics of various wheat varieties, as supported by recent studies on the evolution and improvement of wheat varieties in China. Farmers will be organized for regular visits, during which relevant experts will provide on-site explanations to enhance participants' understanding and confidence in wheat varieties. A diversified information dissemination channel will be established by integrating resources from agricultural departments, research institutions, and seed enterprises, forming an "online + offline" platform. Online, short videos and mobile apps will be used to disseminate information on a variety of characteristics and planting techniques; offline, rural radio Broadcasts, township agricultural technology stations, and village bulletin boards will publicize the recommended list of dominant varieties, and regular exhibitions of wheat varieties along with technical lectures will be organized.

4) Utilizing agricultural policy optimization to enhance the effectiveness of guidance

On the one hand, efforts should be intensified to promote and interpret policies through diverse approaches such as door-to-door outreach, policy seminars, and explanatory videos. These initiatives aim to raise farmers' awareness of wheat seed variety promotion policies, subsidy schemes, and agricultural insurance programs. During policy promotion, specific case studies should be employed to illustrate tangible benefits, thereby enhancing farmers' trust and confidence in seed purchasing. Moreover, a feedback mechanism should be established to promptly collect farmers' needs and opinions, facilitating dynamic adjustments to policy content and enhancing their relevance and effectiveness.

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## Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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