How Does Perceived Value Affect Kiwi Growers' Sustainable Application of Green Agricultural Technology in China? - Moderating Effect Analysis Based on Government Support

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Research Article

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Abstract

Unsafe use of pesticides and fertilizers is a concern in rural areas of China, resulting in serious threats to environment and the quality of agricultural products. Many works have studied the factors influencing the adoption of green agricultural technology by farmers. However, few studies have explored the factors that lead to a farmer's sustainable use of green agricultural technology. Based on a survey of 1,138 kiwi growers in Shaanxi province of China, this paper builds a theoretical model to look at this issue and conducts a series of empirical exercises to gain insight into the effects of perceived value, government support and their interaction on kiwi growers' sustainable application of green agricultural technology. We find that (1) Perceived monetary and non-monetary benefits positively affect the sustainable application of green agricultural technology by farmers while perceived monetary and non-monetary risks affect it negatively. In addition, such influence would be enhanced with an increase in the intensity of perceived value and vary with the type of green agricultural technology. (2) Both agricultural extension service and ecological subsidy, as two main forms of government support, have a positive and significant effect on the sustainable application of green agricultural technology. (3) There is also a role for the interaction effects between the influence of perceived value and government support on the sustainable application of green agricultural technology. Therefore, it has been proposed in this paper that the government should expand relevant publicity, education, training, and guidance, offer compensatory incentives for producers, and adopt guiding methods corresponding to different green agricultural technology, so as to promote the sustainable application of green production modes by farmers.

1. Introduction

China is the most populous country in the world, and agriculture has played a prominent role in the country's remarkable economic achievements (Liu et al., 2018). Nevertheless, China's agriculture industry is still in a stage of extensive development. The substantial development of agriculture has boosted energy demand and also led to severe environmental pollution (Yang et al., 2018). The high levels of pollution and emissions from agriculture pose a threat to the future of the nation's food and ecological security (Jiao et al., 2020; Liu and Feng, 2019). With agriculture being fundamental to the Chinese economy, green agricultural practices come into focus as one driving force, while helping to reduce pollution and maintain a sustainable ecology at the same time (Liu et al., 2020).

In October 2017, the 19th National Congress of the Communist Party of China proposed the implementation of a rural revitalization strategy. But what would be the best road to realize this goal that is also mindful of the Chinese-specific nature of the industry? The answer is that we must adhere to the harmony between man and nature and choose the green development of rural areas. The No.1 Central Documents in 2018, 2019 and 2020 all required further steps to reach zero growth in the use of chemical fertilizers and pesticides, pilot projects for organic fertilizing technologies. They also put a high priority on agricultural water-saving methods, an area of great strategic significance, as well as large-scale implementation of water-saving projects. General Secretary Xi Jinping also mentioned that, during the agricultural development, no more mistakes should be made concerning the ecological environment. He also insisted that those mistakes made in the past have to be gradually remedied, so that the fight against agricultural non-point source pollution can triumph. Currently, the main concern is how to encourage farmers to abandon their traditional ways and opt for environmentally sound practices. Only through this shift resources can be conserved and environment can be protected.

Internationally, there has been a great deal of interest in finding what factors encourage farmers to switch to green agricultural technology. In Iran, farmers that were more likely to support biological control of their farms were found to be better educated, more experience, and had frequent extension contacts. They also had a higher share of family labor force in farming activities as well as the understanding of the damages that pesticide use can do to the
environment (Abdollahzadeh et al., 2015). In Southeast Asia, pesticide use among farmers who sought advice from friends and neighbors was 45% less, whereas use among those who sought advice from pesticide shopkeepers was 251% more. Pesticide use was 42% less when a woman was in charge and 31% less when farmers had adopted biopesticides (Chetna et al., 2012; Schreinemachers et al., 2017). Möhring et al. (2020) analyze the link between crop insurance and pesticide use in Europe. They found a positive and significant relationship between the two. In Bangladesh, low levels of education, lack of knowledge, and pursuit of higher profits were found to be the main reasons for the inadequate attention to the use of pesticides (Akter et al., 2018). Other studies in this area have suggested that lean thinking had a spill-over effect on existing green practices (Barth and Melin, 2018; King and Lenox, 2001). Also, age, health effects, pesticide toxicity class and training are within the scope of consideration (Berni et al., 2021; Ray and Ghose, 2014; Salvatore et al., 2015; Sharafi et al., 2018).

In China, there has been an implementation of the household contract responsibility system. Since then, farmers have gained importance in rural activities and are now the principal decision-makers. Their application of micro green farming technology is related to major strides in China's agricultural green transformation. Studying the role different factors play in farmers'decision making process helps to accelerate the scientific approach and the revitalization of the environment. An urgent part of that strategy is to understand the incentives behind the use of pesticides and fertilizers in rural populations, and especially in developing countries (Khan and Damalas, 2015). For these reasons, there have been many studies in China that look into this issue and offer policies and strategies that will accelerate the move to green production. Existing works show that the adoption of green production technologies is mainly driven by internal factors but also by external environmental factors. The important internal factors are: gender, age, health condition, education, income, non-agricultural transfer of labor, and household land endowment (Liang et al., 2012; Lu et al., 2020; Lu and Xie, 2018; Migheli, 2017; Wu et al., 2013; Xu et al., 2017). Important external factors are: social capital, Market incentive, government regulation, subsidies, Agricultural insurance, Industrialization organization participation, and education programs (Chen et al., 2009; Chen et al., 2017; Fan et al., 2015; He et al., 2016; Huang et al., 2008; Luo et al., 2014; Wang et al., 2019; Zeng and Mu, 2010).

With a rising interest on this subject internationally and also in China and the increasing role of cross-over fields on economics, scholars are paying increasing attention to psychological factors affecting farmers. In addition to individual factors, family endowments and external factors, it is important to study how the farmer's subjective feelings and psychological perception of the surrounding environment, especially their perception of risks, guide their decision making process when it comes to environmental behavioral (Liu et al., 2018; Zhang and Jiang, 2016). Despite many works in this area, there is still no consensus on which of these factors is the most influential. In most studies, perceived risks from switching to green agriculture was strongly associated with the level of green technology adoption (Cheng et al., 2019; Liu and Zhou, 2018; Riwthong et al., 2017; Wang et al., 2017b; Zhou et al., 2020). This was especially true among both the older and younger generations of farmers but at different levels (Liu et al., 2020a). However, Xie et al. (2013) (Xie, 2013) believed that there was a negative correlation between perceived risks and farmers' life decisions, as those showing stronger perception of risks tend to isolate themselves from the outside world. Similarly, Pan et al. (2020) (Pan et al., 2020) and Jallow et al. (2017) (Jallow et al., 2017) hypothesized that risk-averse farmers were more likely to use more pesticides. In the same vein, some scholars had found that there was little correlation between environmental risk perception and the adoption of suitable ecological behavior (Wu et al., 2014).

As for risk perception and whether it has an impact on the adoption of green technologies, no consensus has been reached in the existing literature. The reasons may be as follows: Firstly, the uncertainty of agricultural production and the diversity of technical choices make farmers switch technologies to green farming in stages (Bhattacherjee, 2001). Farmers often trial new modes of production before fully committing to it; thus, covering only one year would not be
enough to observe the full decision-making process of adopting green agricultural technology by farmers, as is the case with most existing works. Most existing studies lack continuity by only focusing on a certain point in time. Secondly, most works have been looking at a specific technology and have focused on a single green production technology. Such limited scope does not reflect the overall implementation process. Thirdly, with reference to the farmer rationality, which is the basis of analyzing their behavioral decision-making, the decisions farmers make are not only driven by perceived risks. The key to their decision-making is the process of weighing the risks and interests against each other. There is a trade-off between risks and interests.

In addition, it is true that farmers tend to acquire useful technical knowledge through field guidance, technical training and consulting services provided by government before they engage in green production activities. However, the adoption of new technology often means that farmers need to bear additional costs. Without subsidies to lessen the burden, farmers could be discouraged. The government has an array of programs for environmental conservation and rehabilitation. The most relevant one is Payments for Environmental Services (PES) program. PES monetizes the value of reduced environmental pollution and other externality costs. A restructuring of PES could accelerate the pace of technology switch (Bianco, 2016; Adele Bianco, 2016). In conclusion, government provided agricultural extension service and subsidy have a direct effect on how farmers perceive the value of green technologies and could boost the rate of sustainable application.

In view of this argument, this paper introduces the perceived value theory from two dimensions—perceived benefits and perceived risks (He et al., 2016; Li et al., 2020), which may help clarify, in a comprehensive way, the mechanism behind the psychological factors on the sustainable application of green agricultural technology by farmers. We apply a Probit model for empirical study, illustrating the influence of perceived value, government support and their interaction on the sustainable application of green agricultural technology by farmers.

The contributions we make to the current academic research is as follows: (1) Numerous works have studies the drivers of green agricultural technology adoption. However, few have been mindful of whether the behavior is sustained for more than one year for different technology. According to the "one control and two reductions" rule in China, the sustained application of water-saving irrigation technology, green pest prevention and control technology, and organic fertilizer replacement technology are selected as the objects of this study for a comprehensive look at the sustainable application of green agricultural technology. (2) We infuse perceived value theory into our analysis framework and consider both perceived benefit and risk in conjunction with government support for a fuller and more detailed understanding of the underlying mechanism. (3) Most existing studies focus on grain crops and vegetable crops. Few are centered around fruit production. The kiwi producing area in Shaanxi Province of China is one of the largest of its kind in the world, often ranked first in the country and the world for its area and yield. However, few have quantitatively studied the sustainable adoption of green technology by farmers in this region based on large-scale field survey data. Therefore, it is strongly representative and very significant to study the sustainable application of green agricultural technology by kiwi growers in Shaanxi Province. The findings of this paper can help shed a light on the decision-making mechanism and help to make green agricultural technology more popular. Moving in this direction will boost the income of farmers and improve the ecological environment in Northwest China and, by extension, throughout the whole country.

2. Theoretical Analysis And Research Hypothesis

2.1. Perceived value and sustainably application of green agricultural technology
Perceived value is the utility that people will receive by weighing possible perceived benefits and risks of a new product or service against each other. It is a type of subjective cognition (Flint et al., 2002; Foster and Rosenzweig, 1995; Monroe, 2002; Parasuraman and Grewal, 2000; Zeithaml, 1988). According to behavioral economics, rational individuals have an interest to boost their profits and avoid risks. Subjective feelings and psychological perception, as internal driving forces (Liu et al., 2013), come into the decision-making process (Sweeney and Soutar, 2001). All of these suggest that it is important to study the application of green agricultural technology by farmers from the perspective of perceived value. Gronroos and Woodruff (1997) believed that perceived value relies on both gains and losses. The perceived value of the sustainable application of green agricultural technology by farmers is their perception of the expected net benefits and risks of their sustainable application of those technologies.

The benefits and risks can be understood as they are in the economic field as well as in other scenarios. There are many economic or environmental benefits from the application of green agricultural technology (Martey et al., 2019), but, so far, the evidence has been unclear on whether a boost to the farmer's income is one of them. There is some evidence that the green agricultural technology are conducive to a higher income (Abdulai and Huffman, 2014; Donkor et al., 2019; Parvathi and Waibel, 2016; Qiao et al., 2018). However, there is also evidence that it has no effect (Pietola and Lansink, 2001; Tovar et al., 2005) or that there might be an adverse effect (Xing and Zhou, 2014). Therefore, it is particularly important for a currency, as the carrier of perceived value, to be factored into the index system. This paper takes into account four aspects in the analysis: perceived monetary benefits, perceived non-monetary benefits, perceived monetary risks and perceived non-monetary risks.

Perceived monetary and non-monetary benefits refer to the sum of expected economic benefits, but also environmental improvement, village development and self-actualization perceived by farmers during the sustainable application of green agricultural technology. If they expect to use the green agricultural technology sustainably to increase their earnings, to enhance the quality of their agricultural land leading to higher yields, have more access to government subsidies, lower interest loans and use other policies favorable to them, they will be more eager about the practice. The expected monetary benefits will boost their perceived monetary benefits. One impediment to the measurement of non-monetary benefits, however, is quantifying them in terms of monetary value. If ecological and social benefits resulted from sustainable application of green agricultural technology by farmers, such as the improvement of ecological environment and better village development, are widely recognized, then the expected non-monetary benefit will also promote their perceived non-monetary benefits. As higher perceived benefits brings a greater tendency for farmers to conduct sustainable application of green agricultural technology, one would expect a positive correlation between the two.

Risk perception, on the other hand, could be influenced by the judgment of and attitude towards a diverse range of objective risks (Asravor, 2019; Cox, 1967; Keh et al., 2002; Pidgeon et al., 1992). The level of uncertainty embodied in each perceived risk can have an effect on the decision. Similarly, during the sustainable application of green agricultural technology by farmers, their perceived risks are the subjective perception and psychological feelings of the uncertain results and obstacles. Perceived monetary risks are those of high investment costs and low income perceived by farmers in the application of green agricultural technology. One example would be if purchasing funds are required to adopt technologies for the organic fertilizing technology. Sufficient funds are also needed in the construction and maintenance of water-saving irrigation facilities. It is hard to use a monetary value to quantify perceived non-currency risks. There is also increased physical and mental pressure on farmers from changing methods. They have to spend time to learn the new technologies, have to put in more labor into it. They could also be facing objections from family members. As higher perceived risks discourage farmers from conducting sustainable application of green agricultural technology, the former has a negative correlation with the latter.
As a result, our first hypothesis can be stated as follows:

H1a: perceived monetary benefits and non-monetary benefit positively affect the sustainable application of green agricultural technology by farmers.

H1b: Perceived currency risks and non-currency risks negatively affect the sustainable application of green agricultural technology by farmers.

2.2. government support and sustainably application of green agricultural technology

Any decision to apply the new technologies by farmers is a trade-off between costs and benefits. However, farmers often do not have the necessary technical knowledge to understand and evaluate all the benefits and risks involved (Feder and Slade, 1986). Farmers’ pesticide and fertilizer overuse is driven by limited knowledge and low awareness of risks (Fan et al., 2015). Providing proper training and improving the depth and breadth of farmers field of knowledge can have a positive impact (Jannick, 1985). At present, farmers have the agricultural extension service as the main channel for acquiring knowledge and technical training in green agricultural production (Khan et al., 2015). The results, so far, are promising. In addition, benefits of the application of green agricultural technology comprise of two parts: social-ecological benefits and private income. When the private income of farmers is lower than their investment and opportunity cost of labor, their behaviors will be greatly affected (Jia and Lu, 2018). This is when government incentives, such as subsidy, will be the most impactful (Grzelak et al., 2019).

Using this argument, we arrive at our second hypothesis, which is as below:

H2: Government support (agricultural extension service and ecological subsidy) positively affects the sustainable application of green agricultural technology.

2.3. Influence of the interaction term between perceived value and government support on the sustainable application of green agricultural technology

There is a causal ordering from knowledge to perceived value to the safe behaviors of green agricultural technology of farmers, which means value perception is influenced by knowledge which in turn enhances safe green agricultural technology practices (Wang et al., 2017a). More knowledgeable farmers are better poised to avoid risks. However, acquiring that knowledge takes time and effort (Yang et al., 2014). Some technologies are so complicated that it is difficult for farmers to grasp and master them. Agricultural extension service by the government plays a role by making the knowledge more accessible and faster to learn for farmers, especially those in remote areas. Agricultural extension service can also help to improve farmers’ scientific competence, optimize the allocation efficiency of inputs, and reduce stress. This results in higher perceived non-monetary benefits and lower perceived non-monetary risks for farmers. On the other hand, it is now necessary for China to realize the internalization of the non-market part of green agricultural production by taxing polluters and subsidizing the ecological-environmental protection entities. Farmers will respond by adjusting their perceived value and taking action based on the new situation. Ecological subsidy improves perceived monetary benefits and reduce perceived non-monetary risks by reducing the marginal cost of sustainable use of green agricultural technology.

Based on these reasons, we state our third hypothesis as follows:

H3: Government support (ecological subsidy and agricultural extension service) have a moderating effect on the relationship between perceived value and farmers’ sustainable application of green agricultural technology. 

see Fig. 1
3. Data And Variables

3.1. Data sources

The data used in this study are from a field survey of kiwi farmers in Shaanxi province in China. The survey was conducted from June to August 2020. Zhouzhi, Meixian, Wugong counties and Yangling district, are included in the survey. These areas are the largest kiwi production hubs, in terms of both area and yield, in China (see Fig. 2). The choice ensures that the sample is almost representative and also the farmers included are similar enough. At present, kiwi growers often overuse pesticides and fertilizers in a bid to increase their earnings, which not only affects the quality of kiwis, but also causes a series of potential environmental risks. Understanding how this situation can be averted in Shaanxi Province would have a great overall impact owing to the share of the area from national production.

We also conducted a preliminary investigation in Lichen and Zhaixi villages, in Yangling district to check the reliability and the validity of the questionnaire. In this phase, a total of 100 questionnaires were distributed and the response rate was 98%. The reliability and validity of questionnaires were pre-tested, and a few unscientific indicators were eliminated. The questionnaire was revised in the light of the responses and after consulting with experts, and a finalized version was prepared.

To choose our sample, we used a combination of hierarchical and random sampling. The process is as follows: First, we randomly selected three to four townships from Zhouzhi, Meixian, and Wugong counties and Yangling district. Then, four villages were randomly selected from each township. Finally, we randomly selected 20 to 30 ordinary households from each village depending on the village size. In total, A total of 1,200 questionnaires were distributed, with a response rate of 100%. After eliminating questionnaires with missing data and invalid responses, we are left with 1,138 valid questionnaires, or about 95% of the total. Interviews were conducted face-to-face and interviewers were trained for the purpose beforehand.

3.2. Sample description

The distribution of sampled kiwi growers, such as their personal endowment, family characteristics and production and operation status, is shown in Table 1. There are more female farmers than male ones, accounting for close to 56% of the total sample. In terms of age, the largest group in our sample is in the range 50–65 and accounts for 35.3% of the total. This group is followed by the age group 35–50, which accounts for 27.1% of the total. Due to a rapid process of urbanization, an increasing number of young people are leaving rural areas to work in the major cities. This emigration of the young generation is the main reason agricultural labor force is mostly comprised of older people. In terms of education level, the majority of farmers have fewer than 9 years of schooling. Only 5.9% of the people surveyed had more than 12 years of schooling. Compared to urban areas, the level of education among farmers is relatively lower. Concerning land area, the area that most farmers put into production is small. About 81.3% of kiwi growers have a land smaller than 0.6 hectares. Good quality farmland accounts for 31.5% of the total. Only 9.6% of farmers think that their farmland is of poor quality. Most families have 4 or fewer laborers. And only 3.8% of families have more than 4 people working on their land. The income of 53.4% of farmers is between 30,000 and 60,000 yuan. The average annual income of farmers is about 66,900 yuan. A total of 43.24% of kiwi growers have joined cooperatives(see Table.1).
Table 1
Demographic profile of the sample (n = 1138).

| Statistical indicators       | Frequency | Percentage (%) |
|------------------------------|-----------|----------------|
| Gender                       |           |                |
| female                       | 636       | 55.89          |
| male                         | 502       | 44.11          |
| Age (year)                   |           |                |
| [20,35)                      | 222       | 19.50          |
| [35,50)                      | 308       | 27.07          |
| [50,65)                      | 402       | 35.33          |
| above 65                     | 206       | 18.10          |
| Year of schooling (year)     |           |                |
| [0,6)                        | 299       | 26.27          |
| [6,9)                        | 542       | 47.63          |
| [9,12)                       | 231       | 20.29          |
| above 12                     | 66        | 5.89           |
| Number of labourers          |           |                |
| [1,2]                        | 634       | 55.71          |
| [3,4]                        | 426       | 37.43          |
| above 5                      | 78        | 6.85           |
| Farmland quality             |           |                |
| very bad                     | 61        | 5.36           |
| bad                          | 122       | 10.72          |
| indifferent                  | 447       | 39.28          |
| good                         | 353       | 31.02          |
| very good                    | 155       | 13.62          |
| Farm size (Mu)               |           |                |
| [0,5)                        | 411       | 36.12          |
| [5,10)                       | 514       | 45.17          |
| [10,20)                      | 135       | 11.86          |
| above 20                     | 78        | 6.85           |
| Annual household income (wan yuan) |   |                |
| [0,3)                        | 182       | 15.99          |
| [3,6)                        | 612       | 53.78          |
| [6,9)                        | 240       | 21.09          |
| above 9                      | 104       | 9.14           |
| Whether to join a cooperative or not |     |                |
| yes                          | 501       | 44.02          |
| no                           | 637       | 55.98          |
| Variable | Definition | Mean  | Std.  |
|----------|------------|-------|-------|
| Perceived Value | Do you agree that Sustainable Application of Green Agricultural Technology can lead to better product prices and help farmers get facilities or subsidies from the government, thus helping to increase their income: Yes = 1, No = 0 | 0.653 | 0.476 |
| Perceived monetary benefits | Very strong = 5, strong = 4, indifferent = 3 weak = 2, very weak = 1 | 2.652 | 1.267 |
| Intensity of Perceived monetary benefits | Do you agree that Sustainable Application of Green Agricultural Technology can save resources, optimize the environment, and gain people's respect and approval: Yes = 1, No = 0 | 0.501 | 0.500 |
| Perceived non-monetary benefits | Very strong = 5, strong = 4, indifferent = 3 weak = 2, very weak = 1 | 2.401 | 1.064 |
| Perceived monetary risks | Do you agree that Sustainable Application of Green Agricultural Technology may not bring better prices, and it is necessary to spend money on purchasing relevant production materials and maintaining relevant facilities: Yes = 1, No = 0 | 0.616 | 0.487 |
| Intensity of perceived monetary risks | Do you agree that Sustainable Application of Green Agricultural Technology requires extra work and study, you may feel tired and afraid that you are not professional, and there may be family conflicts caused by different opinions: Yes = 1, No = 0 | 0.671 | 0.469 |
| Perceived non-monetary risks | Very strong = 5, strong = 4, indifferent = 3 weak = 2, very weak = 1 | 3.276 | 1.119 |
| Green Agricultural Technology | Have you continued to use water-saving irrigation for more than two years: Yes = 1, No = 0 | 0.139 | 0.347 |
| Water-saving irrigation Technology | Have you continued to use green pest prevention and control Technology for more than two years: Yes = 1, No = 0 | 0.609 | 0.488 |
| Green pest prevention and control Technology | Have you continued to use organic fertilizers Replacement Technology for more than two years: Yes = 1, No = 0 | 0.210 | 0.407 |
| Organic fertilizers Replacement Technology | Do you receive the government agricultural extension service: Yes = 1, No = 0 | 0.561 | 0.497 |
| Agricultural extension service |  |  |  |
### 3.3. Farmer’s application of green agricultural technology and their sustainability of behaviors

Of the 1,138 kiwi growers surveyed, 168 have applied water-saving irrigation technology, 159 of whom (94.6%) have continuously practiced such technologies for over 2 years. These numbers suggest that kiwi growers who have started applying water-saving irrigation technology generally keep doing so. Regarding the replacement of chemical fertilizers by organic ones, 778 farmers respond affirmatively, of which 694 (or about 89.2%) have carried on with this practice for longer than one year. Most farmers in our sample have continuously applied such technologies. Of the farmers in our sample, 566 have applied green pest prevention and control technology, 239 of which have managed to carry on with the practice for more than one year. Overall, 57.8% of the growers in our sample have resorted back to chemical pesticides after using organic ones (see Fig. 3).

### 3.4. Definition of variables

The core explanatory variable for our analysis is the perceived value. Based on the earlier discussion, perceived value comes in four ways: perceived monetary value, perceived non-monetary value, perceived monetary risks, and perceived non-monetary risks. The value for each is assigned to 1 if the farmer says yes to it, otherwise it is 0. At the same time, in order to study the influence of perceived value intensity on the sustainable use of green farming technology, a Likert scale with five-values was adopted in this paper to assign values to indicate the intensity, namely: 1 = little, 2 = very little, 3 = indifferent, 4 = strong, and 5 = very strong.

The dependent variable is the farmers continued use of green agricultural technology. According to the agricultural pollution prevention and control method of "one control, two reduction and three basic" guideline in China, water-saving irrigation technology, green pest prevention control technology and organic fertilizer replacement technology...
are selected as the main topics in this paper. The questionnaire asks the question whether they have been using these technologies for two consecutive years or more. The variable is one if farmer answered yes, and zero otherwise.

The moderating variable is government support. It is meant to examine whether the impact of farmers’ perceived value on the sustainable use of green farming technology was different due to government technical extension services and ecological subsidies. We collect the relevant data by asking our subjects “Do you receive the government technical extension services” and “Do you receive the government ecological subsidy?”. A positive answer is coded as one and a negative one is coded as zero.

Compared to the traditional planting methods, water-saving irrigation technology, green pest prevention and control technology and organic fertilizer replacement technology are resource-saving, capital-intensive and technology-intensive. Therefore, based on the existing studies, this paper also selects factors such as household characteristics, family characteristics and management characteristics as control variables (QIN and LÜ, 2020). (see Table. 2)

### 3.5. Model specification

The purpose of this study is to investigate the relationship between perceived value, government support and farmers’ sustainable use of green agricultural technology. Our variable that indicates whether green farming has been in use continuously is a binary one, therefore, we analyze it using a Probit model. Specifically, the model we estimate is

$$\text{Probit(Adoption)} = \Phi(\beta_0 + \beta_1 \text{Value} + \beta_2 \text{Recon})$$

Where Adoption is the explained variable, denotes farmers’ choices for sustainable use of green farming technologies; Value represents the perceived value of farmers; Fecon represents the control variable $\beta_1$ represents the coefficient to be estimated.

### 4. Empirical Analysis

We begin by testing whether there is multicollinearity between the independent variables. Our results show that variance inflation factors are all smaller than 2. Therefore, the independence principle applies to all of our variables and collinearity should not be an issue. We have, further, decentralized the cross terms to reduce any possibility of collinearity. We also compute indicators such as -2 times log of likelihood, LR $\chi^2$, and Prob $\chi^2$ to evaluate the quality of our estimates. Specifically, -2 times log of likelihood refers to the negative two multiplied by the value of the log likelihood function. The smaller the value of this statistic, the better the imitative effect of our model. LR $\chi^2$ is the chi-squared test statistic, and Prob $\chi^2$ is the $p$ value of the test. The larger the LR $\chi^2$, or the smaller the $p$ value, the better the significance of our model.

#### 4.1. Impact of perceived values

We use Stata to conduct a Probit regression. The dependent variable ($Y$) is set to whether farmers sustainably adopt water-saving irrigation technology, green pest prevention and control technology, organic fertilizer replacement technology for more than one year. The estimated results are shown in Table 3. It can be drawn from models (1), (3) and (5) that the influence of perceived monetary benefits on green pest prevention and control technology and organic fertilizing technology is significant at the level of 1%. The magnitude of the coefficients are 0.353 and 0.134, respectively. However, perceived monetary benefits has an insignificant effect on the sustainable use of water-saving irrigation technology. One reason for this result could be that it does not have a substantial impact on the farmer’s income in short term, though it can enhance the efficiency of present water resource utilization, despite the fact that the lack of water resources is the bottleneck of agricultural development. perceived non-monetary benefits has a
positive and significant effect on all three of the green practices. The corresponding coefficients are 0.627, 0.779 and 0.744, respectively. Farmers seem to take note of the external benefits coming from green agricultural technology. Perceived monetary and non-monetary risks have a negative effect on all the three green practices. Whether the perception of risk is emanating from financial reasons, usability of technologies, or objections from family members, it does adversely impact a farmer’s sustainable application of green agricultural technology.
Table 3
Impact of perceived values

| variable                        | Water-saving irrigation Technology | Green pest prevention and control Technology | Organic fertilizers Replacement Technology |
|---------------------------------|-----------------------------------|---------------------------------------------|---------------------------------------------|
|                                 | (1)                               | (2)                                         | (3)                                         | (4)                                         | (5)                               | (6)                                         |
| Perceived monetary benefit      | 0.159 (0.179)                     | 0.353** (0.161)                             | 0.134*** (0.205)                            |                                              |                                  |                                              |
| Intensity of perceived monetary benefit | – (0.058)                         | 0.150*** (0.056)                            | 0.169*** (0.056)                            | 0.126*** (0.035)                            |                                  |                                              |
| Perceived non-monetary benefit  | 0.627*** (0.136)                  | 0.779*** (0.116)                            | 0.744*** (0.145)                            |                                              |                                  |                                              |
| Intensity of perceived non-monetary benefit | – (0.074)                        | 0.516*** (0.078)                            |                                              | 0.068* (0.043)                              |                                  |                                              |
| Perceived monetary benefit      | -1.404*** (0.147)                 | -1.329*** (0.116)                           |                                              | -1.869*** (0.203)                           |                                  |                                              |
| Intensity of perceived monetary risk | – (0.064)                       | -0.508*** (0.072)                           |                                              |                                              | -0.213*** (0.039)                        |                                              |
| Perceived non-monetary risk     | -1.188*** (0.128)                 | -0.923*** (0.108)                           |                                              | -0.713*** (0.162)                           |                                              |                                              |
| Intensity of perceived non-monetary risk | – (0.061)                       | -0.296*** (0.066)                           |                                              |                                              |                                              | -0.032* (0.037)                          |
| Education                       | 0.166*** (0.031)                  | 0.185*** (0.033)                            | 0.047* (0.028)                              | 0.081** (0.033)                             | 0.088** (0.039)                        | 0.040* (0.021)                          |

Note: Numbers in parentheses are robust standard errors. ***, ** and * indicate significance at the level of 1%, 5% and 10%, respectively.
| variable                      | Water-saving irrigation Technology | Green pest prevention and control Technology | Organic fertilizers Replacement Technology |
|-------------------------------|-----------------------------------|---------------------------------------------|--------------------------------------------|
|                               | (1)                               | (2)                                        | (3)                                        |
| Health conditions             | 0.283**                          | 0.313***                                   | 0.128**                                    |
|                               | (0.086)                           | (0.087)                                   | (0.076)                                   |
|                               |                                   |                                             | 0.128                                      |
|                               |                                   |                                             | (0.083)                                   |
|                               |                                   |                                             | 0.137***                                   |
|                               |                                   |                                             | (0.049)                                   |
| Lab                           | -0.069                            | -0.102                                     | -0.008                                     |
|                               | (0.066)                           | (0.068)                                   | (0.059)                                   |
|                               |                                   |                                             | -0.031**                                   |
|                               |                                   |                                             | (0.070)                                   |
|                               |                                   |                                             | -0.174**                                   |
|                               |                                   |                                             | (0.021)                                   |
|                               |                                   |                                             | -0.200***                                 |
|                               |                                   |                                             | (0.043)                                   |
| Income                        | 0.044                             | 0.062                                      | 0.113**                                    |
|                               | (0.047)                           | (0.049)                                   | (0.042)                                   |
|                               |                                   |                                             | 0.148**                                    |
|                               |                                   |                                             | (0.072)                                   |
|                               |                                   |                                             | 0.003                                      |
|                               |                                   |                                             | (0.054)                                   |
|                               |                                   |                                             | 0.083*                                     |
|                               |                                   |                                             | (0.030)                                   |
| Farmland quality              | 0.325***                         | 0.359***                                   | 0.230***                                   |
|                               | (0.073)                           | (0.078)                                   | (0.065)                                   |
|                               |                                   |                                             | 0.148***                                   |
|                               |                                   |                                             | (0.049)                                   |
|                               |                                   |                                             | 0.070*                                     |
|                               |                                   |                                             | (0.088)                                   |
|                               |                                   |                                             | 0.226***                                   |
|                               |                                   |                                             | (0.051)                                   |
| Traffic conditions            | 0.039                             | 0.009                                      | 0.038                                      |
|                               | (0.085)                           | (0.085)                                   | (0.077)                                   |
|                               |                                   |                                             | 0.012                                      |
|                               |                                   |                                             | (0.081)                                   |
|                               |                                   |                                             | 0.038                                      |
|                               |                                   |                                             | (0.092)                                   |
|                               |                                   |                                             | 0.083*                                     |
|                               |                                   |                                             | (0.048)                                   |
| Farming size area             | 0.009                             | 0.001                                      | 0.030*                                     |
|                               | (0.019)                           | (0.019)                                   | (0.016)                                   |
|                               |                                   |                                             | 0.035                                      |
|                               |                                   |                                             | (0.019)                                   |
|                               |                                   |                                             | -0.009                                     |
|                               |                                   |                                             | (0.021)                                   |
|                               |                                   |                                             | 0.039***                                   |
|                               |                                   |                                             | (0.011)                                   |
| Whether to join a cooperative or not | 0.575**                          | 0.610***                                   | 0.018                                      |
|                               | (0.175)                           | (0.181)                                   | (0.146)                                   |
|                               |                                   |                                             | 0.058                                      |
|                               |                                   |                                             | (0.173)                                   |
|                               |                                   |                                             | 0.027                                      |
|                               |                                   |                                             | (0.020)                                   |
|                               |                                   |                                             | 0.304***                                   |
|                               |                                   |                                             | (0.105)                                   |
| Constant                      | 0.953**                          | 0.468                                      | 0.138(0.309)                               |
|                               | (0.341)                           | (0.455)                                   | (0.309)                                   |
|                               |                                   |                                             | 1.102**                                   |
|                               |                                   |                                             | (0.457)                                   |
|                               |                                   |                                             | 0.283                                      |
|                               |                                   |                                             | (0.185)                                   |
|                               |                                   |                                             | 1.844***                                   |
|                               |                                   |                                             | (0.314)                                   |
| N                             | 1138                              | 1138                                       | 1138                                       |
| Pseudo R²                     | 0.431                             | 0.478                                      | 0.394                                      |
|                               |                                   |                                             | 0.120                                      |
|                               |                                   |                                             | 0.733                                      |
|                               |                                   |                                             | 0.139                                      |
| -2 loglikelihood              | 523.440                           | 478.356                                    | 708.832                                    |
|                               |                                   |                                             | 476.543                                    |
|                               |                                   |                                             | 406.767                                    |
|                               |                                   |                                             | 654.958                                    |
| LR chi²                       | 397.090                           | 438.240                                    | 460.990                                    |
|                               |                                   |                                             | 690.150                                    |
|                               |                                   |                                             | 1115.46                                    |
|                               |                                   |                                             | 211.330                                    |
| Prob > chi²                   | 0.000                             | 0.000                                      | 0.000                                      |
|                               |                                   |                                             | 0.000                                      |
|                               |                                   |                                             | 0.000                                      |

Note: Numbers in parentheses are robust standard errors. ***, ** and * indicate significance at the level of 1%, 5% and 10%, respectively.
In models (2), (4) and (6), we observe that the intensity of perceived monetary and non-monetary benefits increase the likelihood of the sustainable use of the three green agricultural technology, which indicates that a higher intensity of perceived benefit significantly increases the tendency for farmers to sustainably use green agricultural technology. The intensity of perceived monetary and non-monetary risks has the opposite effect and significantly reduces the likelihood of sustainable use of the three technologies, which indicates that a higher intensity of perceived risk will notably decrease the tendency for farmers to sustainably use green agricultural technology. For robustness check, we additionally estimate an OLS model and find that the qualitative nature of the findings stays the same. These last results are shown in Table 4.
| variable                        | Water-saving irrigation Technology | Green pest prevention and control Technology | Organic fertilizers Replacement Technology |
|--------------------------------|-----------------------------------|---------------------------------------------|-------------------------------------------|
| Perceived monetary benefit     | 0.050** (0.021)                   | -                                           | 0.687*** (0.018)                          |
| Intensity of perceived non-monetary benefit | - (0.007) | 0.031*** (0.007) | - (0.012) |
| Perceived non-monetary benefit | 0.079*** (0.018)                  | -                                           | 0.094*** (0.015)                          |
| Intensity of perceived non-monetary benefit | - (0.009) | 0.083*** (0.009) | - (0.014) |
| Perceived monetary risk        | -0.226*** (0.019)                 | -0.311*** (0.022)                           | -0.217*** (0.017)                         |
| Intensity of perceived monetary risk | - (0.008) | -0.079*** (0.009) | - (0.013) |
| Perceived non-monetary risk    | -0.213*** (0.019)                 | -0.217*** (0.022)                           | -0.078*** (0.016)                         |
| Intensity of perceived non-monetary risk | - (0.008) | -0.046*** (0.008) | - (0.012) |
| Education                      | 0.023*** (0.004)                  | 0.026*** (0.004)                            | 0.010** (0.004)                           |
| Health conditions              | 0.039*** (0.011)                  | 0.041*** (0.010)                            | 0.026** (0.011)                           |
| Lab                            | -0.012 (0.009)                    | -0.014 (0.009)                              | -0.024*** (0.008)                         |
| variable                                      | Water-saving irrigation Technology | Green pest prevention and control Technology | Organic fertilizers Replacement Technology |
|----------------------------------------------|-----------------------------------|-----------------------------------------------|---------------------------------------------|
|                                              | (1)                               | (2)                                           | (3)                                        |
| Income                                       | 0.004                             | 0.008                                         | 0.021***                                   |
|                                              | (0.006)                            | (0.006)                                       | (0.007)                                    |
| Farmland quality                             | 0.053***                          | 0.051***                                      | 0.045***                                   |
|                                              | (0.011)                            | (0.010)                                       | (0.012)                                    |
| Traffic conditions                           | 0.013                             | 0.006                                         | 0.013                                      |
|                                              | (0.010)                            | (0.010)                                       | (0.012)                                    |
| Farming size area                            | 0.001                             | 0.261                                         | 0.005                                      |
|                                              | (0.002)                            | (0.002)                                       | (0.003)                                    |
| Whether to join a cooperative or not         | 0.073***                          | 0.070**                                       | 0.015                                      |
|                                              | (0.023)                            | (0.022)                                       | (0.026)                                    |
| Constant                                     | 0.626***(0.050)                   | 0.469***(0.063)                               | 0.611***(0.057)                            |
|                                              |                                   |                                               |                                             |
| N                                            | 1138                              | 1138                                         | 1138                                      |

**Note:** Values in parentheses represent standard errors. ***p < 0.01, **p < 0.05, *p < 0.1.
Table 5
Impact of government support

| variable                  | Water-saving irrigation Technology | Green pest prevention and control Technology | Organic fertilizers Replacement Technology |
|---------------------------|------------------------------------|---------------------------------------------|-------------------------------------------|
|                           | (1)Probit                          | (2)OLS                                      | (3)Probit                                |
|                           | 0.174*                             | 0.036*                                      | 0.356***                                 |
|                           | (0.113)                            | (0.022)                                     | (0.098)                                  |
|                           | 0.095***                           |                                             | 0.027                                    |
|                           | (0.102)                            |                                             | (0.030)                                  |
| Technical extension service |                                   |                                             |                                          |
| Ecological subsidy        | 0.594***                           | 0.109***                                    | 0.574***                                 |
|                           | (0.109)                            | (0.020)                                     | (0.094)                                  |
|                           | 0.143***                           |                                             | 0.023                                    |
|                           | (0.082)                            |                                             | (0.026)                                  |
| Other control variables   | YES                                | YES                                         | YES                                      |
| Constant                  | 0.332(0.229)                       | 0.353***                                    | 0.413*(0.214)                            |
|                           | (0.049)                            | (0.049)                                     | (0.214)                                  |
|                           | 0.359***                           |                                             | 0.058                                    |
|                           | (0.058)                            |                                             |                                          |
| N                         | 1138                               | 1138                                        | 1138                                     |
| Pseudo R²                 | 0.157                              | —                                           | 0.178                                    |
| -2 loglikelihood          | 776.313                            | —                                           | 1251.327                                 |
| LR chi²                   | 144.220                            | —                                           | 270.900                                  |
| Prob > chi²               | 0.000                              | —                                           | 0.000                                    |
| R-squared                 | —                                  | 0.125                                       | 0.113                                    |

Note: In consideration of space constraints, the estimated results of control variables are omitted

4.2. Impact of government support

Agricultural extension service and ecological subsidy can encourage farmers to consider sustainable use of water-saving irrigation technology, green pest prevention and control technology, and organic fertilizer replacement technology. The estimates show that receiving ecological subsidy raises the probability of sustainable use of the three green agricultural technology by 17.4%, 35.6% and 61.7%. More reasonable ecological subsidies from the government can reduce economic risks faced by farmers in the early stage of green production, and farmers will be more likely to sustainably adopt green agricultural technology. As with regards to the three kinds of technologies, each time when the level of ecological subsidy is increased by 1 unit, the probability of the sustainable application of such technologies by farmers will be enhanced respectively by 17.4%, 35.6% and 61.7%.

The agricultural extension service also have a positive and significant effect on the sustainable use of water-saving irrigation technology, green pest prevention and control technology and organic fertilizer replacement technology, all with significance at 1% level. The values of marginal effects for these three coefficients are 0.594, 0.574 and 0.776, which indicates that each time when the level of agricultural extension service is increased by 1 unit, the probability of sustainable application of such technologies by farmers will be enhanced by 59.4%, 57.4% and 77.6%, respectively. As can be seen from the above empirical results the marginal effect of agricultural extension service in the three green technology is higher than that with ecological subsidy, farmers prefer technical support from government to ecological subsidy(see Table.5).
4.3. Influence of the interaction term between perceived value and government support on the sustainable application of green agricultural technology

So far, we find that both the perceived value and government support have a positive effect on the sustainable use of green agricultural technology by kiwi growers. However, interactive effects may also exist among them, and the mechanism of action among them remains to be explored. In this part, the interaction term between perceived value and government support is inserted into the model to study a possible role.

4.3.1. Water-saving irrigation technology

As can be seen from Table 6, the interaction between perceived monetary benefits and ecological subsidy has a positive effect on sustainable application of water-saving irrigation technology and the corresponding marginal effects is 0.153. It shows that each time when the level of ecological subsidy is increased by 1 unit, the influence of perceived non-monetary benefits on the probability of the sustainable application of water-saving irrigation technology will be enhanced by 15.3%. The interaction between perceived monetary risks and ecological subsidy also has a coefficient that is significant at 1% level and the corresponding marginal effect is 0.631. Receiving ecological subsidy weakens the impact of perceived risk by 61.3%. It shows that higher ecological subsidy mitigates any fear of risks farmers might have.

Table 6
Influence of the interaction term (Water-saving irrigation Technology)

| variable | Water-saving irrigation Technology |
|----------|-----------------------------------|
|          | (1)  | (2)  | (3)  | (4)  |
| Perceived monetary benefits × Ecological subsidy | 0.153* | -    | -    | -    |
|          | (0.121) |      |      |      |
| Perceived monetary risks × Ecological subsidy | -    | 0.631*** | -    | -    |
|          |      | (0.191) |      |      |
| Perceived non-monetary benefits × Technical extension service | -    | -    | 0.840*** | -    |
|          |      |      | (0.103) |      |
| Perceived non-monetary risks × Technical extension service | -    | -    | -    | 0.580*** |
|          |      |      |      | (0.118) |
| Other control variables | YES | YES | YES | YES |
| N | 1138 | 1138 | 1138 | 1138 |
| Pseudo R² | 0.121 | 0.133 | 0.176 | 0.148 |
| -2 loglikelihood | 809.128 | 797.786 | 758.473 | 784.515 |
| LR chi² | 111.410 | 122.750 | 162.060 | 136.020 |
| Prob > chi² | 0.000 | 0.000 | 0.000 | 0.000 |
The interaction between perceived non-monetary benefits and perceived non-monetary risks with agricultural extension service has an effect that is significant at 1% level. The marginal effects are 0.840 and 0.580, respectively. It shows that each time when the level of agricultural extension service is increased by 1 unit, the influence of perceived non-monetary benefits on the probability of the sustainable application of water-saving irrigation technology will be enhanced by 84%, and the influence of perceived risk on the sustainable application of such technology will be weakened by 58%. The marginal effects for the interaction between agricultural extension service and perceived value are stronger than those for the interaction between ecological subsidy and perceived value. There appears to be more demand from farmers for agricultural know-how. Therefore, the government should enhance the depth, validity and breadth of its agricultural extension service so that farmers can master green agricultural technology. The sustainable application of green farming technology will be enhanced as a result.

### 4.3.2. green pest prevention and control technology

In Table 7, the interactions between perceived monetary benefits and perceived monetary risks with ecological subsidy have a positive effect on the sustainable use of green pest prevention and control technology and is significant at 1% level. The interactions between perceived non-monetary benefits and non-monetary risks with agricultural extension service follow suit. The marginal effects are 0.440, 0.517, 0.846 and 0.331, respectively. It shows that each time when the level of ecological subsidy is increased by 1 unit, the influence of perceived monetary benefits on the probability of the sustainable application of green pest prevention and control technology will be enhanced by 44%, and the influence of perceived currency risk on the sustainable application of such technology will be weakened by 51.7%. Each time the level of agricultural extension service is increased by 1 unit, the influence of perceived non-monetary benefits on the probability of the sustainable application of green pest prevention and control technology will be enhanced by 84.6%, and the influence of perceived monetary risks on sustainable application of such technology will be weakened by 33.1%.
| variable                                      | Green pest prevention and control Technology |
|-----------------------------------------------|-----------------------------------------------|
|                                               | (1)                            | (2)             | (3)             | (4)            |
| Perceived monetary benefits                   | 0.440***                        | —                | —                | —              |
| ×Ecological subsidy                           | (0.104)                         |                  |                  |                |
| Perceived monetary risks                      | —                              | 0.517***         | —                | —              |
| ×Ecological subsidy                           | —                              | (0.150)          |                  |                |
| Perceived non-monetary benefits ×Technical extension service | —                              | —                | 0.846***         | —              |
|                                               |                                |                  | (0.916)          |                |
| Perceived non-monetary risks                  | —                              | —                | —                | 0.331***       |
| ×Technical extension service                  |                                |                  |                  | (0.095)        |
| Other control variables                       | YES                            | YES              | YES              | YES            |
| N                                             | 1138                           | 1138             | 1138             | 1138           |
| Pseudo R²                                      | 0.086                          | 0.082            | 0.145            | 0.082          |
| -2 loglikelihood                               | 1062.966                       | 1073.717         | 1000.235         | 1074.451       |
| LR chi²                                       | 100.820                        | 96.100           | 169.58           | 95.37          |
| Prob > chi²                                    | 0.000                          | 0.000            | 0.000            | 0.000          |
Table 8
Influence of the interaction term (Organic Fertilizers Replacement Technology)

| variable | Organic Fertilizers Replacement Technology |
|----------|--------------------------------------------|
|          | (1)            | (2)            | (3)            | (4)            |
| Perceived monetary benefits × Ecological subsidy | 0.516*** | - | - | - |
| (0.154) | | | | |
| Perceived monetary risks × Ecological subsidy | - | 0.075* | - | - |
| (0.117) | | | | |
| Perceived non-monetary benefits × Technical extension service | - | - | 0.917*** | - |
| (0.095) | | | | |
| Perceived non-monetary risks × Technical extension service | - | - | - | 0.160* |
| (0.083) | | | | |
| Other control variables | YES | YES | YES | YES |
| N | 1138 | 1138 | 1138 | 1138 |
| Pseudo R² | 0.184 | 0.093 | 0.159 | 0.095 |
| -2 loglikelihood | 1242.492 | 1080.448 | 1080.331 | 1177.099 |
| LR chi² | 279.740 | 141.780 | 241.900 | 145.130 |
| Prob > chi² | 0.000 | 0.000 | 0.000 | 0.000 |

4.3.3. organic fertilizer replacement technology

The interactions between perceived monetary benefits and risk with ecological subsidy have a positive and significant effect. The same holds for the interactions between perceived non-monetary benefits and risk with agricultural extension service. The marginal effects are 0.516, 0.075, 0.917 and 0.160, respectively. It shows that each time when the level of ecological subsidy is increased by 1 unit, the influence of perceived monetary benefits on the probability of the sustainable application of green pest prevention and control technology will be enhanced by 51.6%, and the influence of perceived monetary risks on the sustainable application of such technology will be weakened by 7.5%. Each time when the level of agricultural extension service is increased by 1 unit, the influence of perceived non-monetary benefits on the probability of sustainable application of green pest prevention and control technology will be enhanced by 91.7%, and the influence of perceived monetary risks on the sustainable application of such technology will be weakened by 16%(see Table.8).

5. Conclusion

5.1. Findings

Using a field survey of 1,138 kiwi growers in Shaanxi production hub, this paper investigates how perceived values, government support and their interactions affect the sustainable use of farmers’ green agricultural technology. There are a few conclusions.
• (1) Perceived values have an impact on the substantial use of green agricultural technology. Perceived monetary and non-monetary returns have a positive effect. Conversely, perceived monetary and non-monetary risks have a negative effect.

• (2) Agricultural extension service and ecological subsidy, as the two main government support, also have a positive and significant impact on the sustainable use of green farming technology.

(3) There is an interaction effect between perceived value and government support on kiwi farmers' sustainable use of green agricultural technology. The effect of perceived values changes when government support is accessed. Among them, ecological subsidy plays a positive moderating role in the relationship between perceived monetary benefits and perceived monetary risks farmers' sustainable use of green farming technology, while agricultural extension service plays a positive moderating role in the relationship between perceived non-monetary benefits and perceived non-monetary risks and farmers' sustainable use of green farming technology.

5.2. Policy implications

One way the government can help the sustainable use of green farming technology is by increasing efforts to publicize these technologies and educate farmers, so that farmers are better aware of the advantages of the practices. For instance, besides using the usual means of broadcasting, slogans and on-site publicity, government can use digital services such as live-streaming, Tik Tok and WeChat Moments to make the services more broadly and more easily accessible, especially to remote rural areas. In this way, more farmers will participate and fulfill their obligation to protect the environment. At the same time, the perceived non-monetary value of green farming will become more obvious and tangible to farmers, encouraging more farmers to join and those that already joined to continue the practice.

As a saying goes, "Give a man a fish and you feed him for a day. Teach a man to fish and you feed him for a lifetime." The government should focus on agricultural extension service, so as to reduce the cost of learning and application of technology for farmers. In the process, farmers increase their income and environment gets protected. Providing platforms for farmers to communicate with the outside world facilitates the learning process by giving farmers the ability to acquire knowledge on their own. The perceived benefits and perceived risks mentioned in this study have a direct impact on the farmers' decisions. Government subsidy is also shown to have a mitigating impact. Increasing subsidy for green production technology adds to their incentives by promising better gains. On the other hand, large subsidy is a burden on the government's budget. Offering farmers better risk management tools (e.g. agricultural insurance) is a lower cost alternative (Möhring et al., 2020). They, too, reduce the perceived monetary risk and increase the perceived monetary benefits. Again, with the extra knowledge and subsidy, farmers are able to evaluate the technology better and reduce risks, thus, be more willing to sustainably use green farming technology.

Declarations

Ethical Approval

Ethical approval was obtained from the School of Economics and Management, Northwest Agriculture & Forestry University.

Consent to Participate

Not applicable

Consent to Publish
Authors Contributions

Wen Xiang: Conceptualization, Methodology, Formal analysis, Writing – original draft. Jianzhong Gao: Methodology, Data curation, Writing -review & editing

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Competing Interests

The authors declare that they have no conflict of interests.

Availability of data and materials

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

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Figures

Figure 1

H3: Government support (ecological subsidy and agricultural extension service) have a moderating effect on the relationship between perceived value and farmers’ sustainable application of green agricultural technology (see Fig.1).
The data used in this study are from a field survey of kiwi farmers in Shaanxi province in China. The survey was conducted from June to August 2020. Zhouzhi, Meixian, Wugong counties and Yangling district, are included in the survey. These areas are the largest kiwi production hubs, in terms of both area and yield, in China (see Fig. 2). The choice ensures that the sample is almost representative and also the farmers included are similar enough. At present, kiwi growers often overuse pesticides and fertilizers in a bid to increase their earnings, which not only affects the quality of kiwis, but also causes a series of potential environmental risks. Understanding how this situation can be averted in Shaanxi Province would have a great overall impact owing to the share of the area from national production.
Of the 1,138 kiwi growers surveyed, 168 have applied water-saving irrigation technology, 159 of whom (94.6%) have continuously practiced such technologies for over 2 years. These numbers suggest that kiwi growers who have started applying water-saving irrigation technology generally keep doing so. Regarding the replacement of chemical fertilizers by organic ones, 778 farmers respond affirmatively, of which 694 (or about 89.2%) have carried on with this practice for longer than one year. Most farmers in our sample have continuously applied such technologies. Of the farmers in our sample, 566 have applied green pest prevention and control technology, 239 of which have managed to carry on with the practice for more than one year. Overall, 57.8% of the growers in our sample have resorted back to chemical pesticides after using organic ones (see Fig. 3).

Figure 3