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The Relationship between Child Rearing Burden and Farmers' Adoption of Climate Adaptive Technology: Taking Water-Saving Irrigation Technology as an Example

Min Cui, Jizhou Zhang and Xianli Xia *

College of Economics and Management, Northwest A&F University, Xianyang 712100, China; xncuimin@nwafu.edu.cn (M.C.); zjz611@nwafu.edu.cn (J.Z.)
* Correspondence: xnxxli@nwafu.edu.cn

Abstract: Exploring the relationship between child rearing burden and farmers' adoption of climate adaptation technologies can be used to improve farmers' adoption of these technologies, thus reducing the impact of climate change on agricultural production and increasing agricultural output. However, with the full implementation of the Chinese three-child policy, the number of children in families will continue to increase and the cost of raising children will rise, which will have a crowding out effect on the adoption of climate adaptive technologies. In this context, we analyzed the impact and mechanism of child rearing burden on farmers' adoption of climate adaptive technology by Probit model and discussed its heterogeneity based on family life cycle theory. Cross-sectional survey data were collected from 511 farm households in the 3 provinces of China to produce the findings. We found that the child rearing burden had a significant negative impact on farmers' adoption of climate adaptive technology. The impact mechanism analysis showed that the child rearing burden mainly affected farmers' adoption of climate adaptive technology through three paths: risk appetite, economic capital and non-agricultural employment, with non-agricultural employment having the largest impact, followed by risk appetite and finally, economic capital. Furthermore, the effect of child rearing burden on the adoption of climate adaptive technology was heterogeneous amid different family life cycles: In the upbringing and burden period, the child support burden had a significant negative impact on the adoption of climate adaptive technology and the impact was greater in the upbringing period, while in the stable period, the child support burden had a significant positive impact on the adoption of climate adaptive technology. The influence mechanism was also heterogeneous in different family life cycles. This paper not only provides research evidence on the relationship between child rearing burden and farmers' adoption of climate adaptive technology, but also has certain empirical value for the formulation and implementation of supportive measures for improving fertility policies.

Keywords: number of children; water-saving irrigation technology; grain production; family life cycle; three-child policy; Loess Plateau

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1. Introduction

As a highly populated country, the Chinese government has always attached great importance to grain production [1]. However, the frequent occurrence of extreme weather events in recent years has exacerbated the vulnerability of land, water and ecological resources, leading to massive reductions in food production and farm household income, and seriously threatening the sustainable development of the economy [2,3]. How to prevent and avoid the negative impact of extreme climate change on agricultural production and social life has become a major issue of continuous concern to the Chinese government and the public [4]. The Food and Agriculture Organization of the United Nations (FAO) proposed "climate smart agriculture", which aims to adapt to the impact of climate change disasters and achieve the goal of sustainable agricultural development. The Chinese government has responded positively and invested US $30.1 million in 2013 with the Global Environment Facility (GEF) to develop climate-smart agriculture, attaching great importance to agricultural climate change risk prevention, control and management; this provides the necessary policy support and foundation for effective disaster prevention and control.

In the face of climate disasters, the application of climate adaptation technology has become one of the most important means of improving the resilience of agricultural production [5,6]. The adoption of climate adaptive technology is a behavioral decision-making process in which people strive to reduce the adverse impact of climate change on their own health and wealth [7], including the following four basic elements: adaptive countermeasures, adaptive behavior, adapters and adaptive effects [8]. As one of the most important participants in agricultural production, exploring the long-term mechanism of farmers' adoption of climate adaptive technology is of great significance to better deal with climate change and reduce the loss of agricultural production [8,9]. In order to improve the farmers' adoption level of adaptive behavior to climate change, scholars began to pay general attention to key influencing factors. Some scholars found that the gender, age, education level and other personal characteristics of farmers are directly related to the adoption of climate adaptive technology [10–12]. Many studies have identified that family characteristics such as family size, total land, off-farm activity and credit behavior have a significant impact on farmers' adoption of climate adaptive technology [11,13,14]. On this basis, some studies have identified that farmers' climate change adaptive behavior is a psychological decision-making process and climate change cognition, risk perception and other factors affect it [15–17]. In addition, several studies have shown that farmers' adaptability to climate change is the main influencing factor when analyzing farmers' adoption of climate adaptive technology, which should be paid attention to in the research [18,19]. However, due to various reasons, the use of climate adaptation technology by farmers is not ideal. There are still some practical problems, such as small scale, low retention rate and poor enthusiasm for adoption [20–22], which hinder further promotion of climate adaptive technology. In Chinese rural areas, the cost of raising children accounts for a large proportion of total household expenditure, which affects farmers' choice of livelihood strategies and agricultural production decisions. However, few scholars have studied the relationship between child rearing burden and climate adaptive technology adoption, which may be a new breakthrough to address this issue.

With the development of society and the improvement of living standards, Chinese rural families pay more and more attention to the cultivation of children, and the cost of support is also increasing. Many families show characteristics of high consumption due to the need to raise children, which leads to the decline of family economic capital. Especially in developing countries, the lack of social security makes farmers bear greater economic pressure when raising their children [23–30]. However, as a capital-intensive technology, climate adaptation technology also requires huge capital investment in equipment in the early stages [31–33]. Thus, the burden of child support leads to the decline of family economic capital, which limits the investment of climate adaptive technologies. In other words, the burden of child support has a crowding out effect on the adoption of climate adaptive technologies. In addition, families invest more time in raising and caring for their children, which can crowd out farmers' time for agricultural production and leave them with insufficient time and energy to learn about climate adaptive technology, thus having a negative impact on the technology's adoption. It is particularly noteworthy that significant changes have taken place in Chinese fertility policy in recent years [34]. During the 14th Five Year Plan period, China proposed to implement the national strategy to actively respond to the aging population and announced the full liberalization of the three-child fertility policy. In other words, Chinese birth policy evolved from a one-child policy, to encouraging two children, and then fully liberalizing three children, which means that the continuous relaxation of the Chinese birth policy will lead to an increase in the number of children in residents' families. Undoubtedly, this will lead to the continuous rise of family rearing costs, thus affecting the existing rural development environment in many fields [35]; this will also inevitably have a profound impact on the promotion and application of climate adaptive technology. In addition, according to the family life cycle theory, the family environment is a dynamic change process. On the one hand, families in different stages of the family life cycle have differences in population structure, consumption structure and livelihood strategy choice [36–38], resulting in the heterogeneity of capital endowment in different periods of families. On the other hand, there are differences in children's consumption across the family life cycle (such as daily consumption, education consumption and house purchase consumption) [39]. In short, the difference in capital endowment and children's consumption in each family life cycle makes farmers bear different upbringing burdens, which results in a deviation on the impact of agricultural production behavior choice. So what is the impact of child rearing burden on farmers' adoption of climate adaptive technology? What is its mechanism of action? Is there heterogeneity in the impact of child rearing burden on farmers' use of climate adaptive technology in different family life cycles? The explanation of these problems is not only conducive to further explore the optimization and improvement path of farmers' adoption of climate adaptive technology, but also provide a basis for the formulation and implementation of supportive measures in fertility policy.

In view of this, this paper uses 511 research samples from three provinces (Shaanxi, Gansu and Ningxia) to empirically test the effect of child support burden on the adoption of climate adaptive technologies by using the Probit model and the mediating effect method. A heterogeneity analysis based on the family life cycle theory is also conducted, which is important for improving the adoption rate of climate resilient technologies and promoting sustainable agricultural development.

2. Theoretical Analysis and Research Hypothesis

2.1. Direct Impact of Child Rearing Burden on Farmers' Adoption of Climate Adaptive Technology

In China, the fragmentation of land and the backward technology of production limit the technical efficiency of agricultural production, so it is difficult for farmers to obtain high economic returns through agricultural production [40,41]. However, due to lack of education and skills, it is difficult for farmers to have other employment options besides agricultural production. Since the farmers themselves are powerless, they put the mission of changing the fate of their families on their children. "Knowledge changes fate", "don't let children lose at the starting line", "education blocks intergenerational transmission of poverty" and other concepts are deeply rooted in people's hearts, so that rural families, in particular, pay great attention to the development of their children. The burden of child rearing accounts for a large proportion of total household expenditures, which has a crowding out effect on the investment in agricultural production and affects the adoption of climate adaptive technologies. In addition, the imbalance in economic development between rural and urban areas in China has led to huge differences in the distribution of educational resources and human capital investment [42], and some farming families may even give up agricultural production to accompany their children to urban areas, thus affecting the adoption of climate resilient technologies. Based on this, the study proposes Hypothesis 1 as:

Hypothesis 1 (H1). *The burden of child support has a significant inhibitory effect on the adoption of adaptive technology by farmers.*

2.2. Effect Mechanism of Child Rearing Burden on Farmers' Adoption of Climate Adaptive Technology

2.2.1. Child Rearing Burden, Risk Appetite and Climate Adaptive Technology Adoption

Families with children are bound to put in a certain amount of time and effort, as well as increased financial and emotional responsibilities, which can increase the pressure on their families to survive [43,44]. For farmers with boys at home, the psychological pressure of "competitive savings" will be generated in order for their sons to have more capital in the future marriage market [45]. In addition, with the development of social economy, the traditional concept of "son preference" has long changed [46,47]. For farmers with girls at home, more and more families hope to give their daughters abundant economic conditions so that their daughters do not have to limit the scope of mate selection due to money [48], which will also increase the pressure on farmers. In short, regardless of whether the children in the family are male or female, raising children will bring economic pressure to farmers' families and lead to the continuous reduction of farmers' risk tolerance. In other words, the more children they need to raise, the greater the pressure they face in the family, and farmers are more inclined to avoid risks when making production decisions.

According to Schultz's small-scale peasant theory, farmers, as rational economic people, usually choose the production mode with low risk and high profit [49]. The different risk attitudes of farmers will produce different expected benefits for the same production behavior and will result in them making different production decisions [50]. As for climate adaptive technology, like other agricultural production technologies, there are unknown risks, which will lead to income uncertainty [51]. At the same time, agricultural economic benefits will face multiple impacts from the market, technology itself and the climate [52–54]. However, due to the imperfect agricultural insurance system, farmers' ability to resist risks in agricultural production is weak. Therefore, the vulnerability of farmers in agricultural production intensifies the impact of risk preference on the adoption of climate adaptive technology; that is, only farmers with a high risk preference can accept the loss caused by the uncertainty of climate adaptive technology and tend to adopt climate adaptive technology. Risk-averse farmers tend to reject the use of climate adaptive technologies in order to reduce production costs. Based on this, the study proposes Hypothesis 2 as:

Hypothesis 2 (H2). *The burden of child support has a significant negative impact on the adoption of climate adaptive technology through risk aversion.*

2.2.2. Child Support Burden, Economic Capital and Climate Adaptive Technology Adoption

The burden of child support has an impact on economic capital through two paths: family expenditure and income. On the one hand, raising children necessitates an increase in the family's expenditure on upbringing, daily life and medical treatment, which will reduce the family's economic capital level [55]. On the other hand, the increase in the number of children will lead to more time and energy spent on childcare by farm household members, which will reduce the female labor supply in the household [56,57], leading to the reduction of total income and inhibiting the improvement of the economic capital level in families [58].

Most climate adaptive technologies (such as water-saving irrigation technology) are capital-intensive production technologies that require farmers to have sufficient capital to invest in production [59]. Therefore, the use of climate adaptive technologies is closely related to capital endowment, especially economic capital, and furthermore, higher economic capital is the basic guarantee for the implementation of climate adaptive technologies. For farmers, the richer the economic capital, the lower the economic burden of adopting climate adaptive technologies, thus promoting their adoption of the technology. Based on this, the study proposes Hypothesis 3 as:

Hypothesis 3 (H3). *The burden of child support has a significant negative impact on the adoption of climate adaptive technologies by reducing farmers' family economic capital.*

2.2.3. Child Rearing Burden, Non-Agricultural Employment and Farmers' Adoption of Climate Adaptive Technology

In order to improve the quality of life and increase the education level of their children, male farmers with children will choose more non-agricultural employment [60]. On the one hand, the burden of child support makes families need more economic support. Compared with agricultural production, non-agricultural employment grants higher incomes [61], so farmers often give up agricultural production and choose non-agricultural employment. On the other hand, studies have shown that there is a strong correlation between parents' and children's occupations. In rural families, parents' non-agricultural employment can help children improve their social and economic status [62]. The reason for this is that compared with rural areas, higher quality educational resources in cities and towns can enable children to receive higher quality education, which is more conducive to knowledge accumulation, ideological exchange and skill improvement, so as to obtain better employment opportunities in the future [63]. Participating in non-agricultural employment provides an opportunity for the children of rural families to move to cities and towns with their parents to receive better education.

Non-agricultural employment has changed the allocation of labor factors of farmers, so that farmers put more labor into non-agricultural industries, and less and less labor time is allocated toward agriculture [64]; that is, the change in the livelihood strategy brought about by non-agricultural employment makes agricultural production face labor supply constraints, which further hinders farmers' adoption of climate adaptive technology [65,66]. In addition, due to non-agricultural employment, the income structure of farmers' families has changed, the proportion of wage income has increased and the contribution of grain planting income has been declining. Therefore, the enthusiasm to participate in agricultural production will be reduced, and the focus will gradually break away from agricultural production and shift to the non-agricultural sector [67,68], so as to reduce the adoption of climate adaptive technologies. Based on this, the study proposes Hypothesis 4 as:

Hypothesis 4 (H4). *The burden of child support has a negative impact on the adoption of climate adaptive technology by improving the level of non-agricultural employment of farmers.*

2.3. Heterogeneity Analysis Based on Family Life Cycle Theory

American social demographer Glick first put forward a relatively complete family life cycle theory [69]. Subsequently, scholars from various countries continuously supplemented and improved this theory based on the social, economic and cultural characteristics of their respective research areas. Derric believes that the stage division of the family life cycle should be redefined according to different research purposes and the completeness of research data [70]. Due to the cultural differences between the East and the West, when using the family life cycle theory to study domestic problems, we need to consider Chinese national conditions and regional differences. According to the characteristics of family population, Wang Wei and others divided Chinese rural families into six life cycle stages: starting period, raising period, burden period, stable period, support period and empty nest period [71]. The division basis of family life cycle is shown in Table 1. Based on the research of Wang Wei and others, this paper divides the family life cycle of the sample, but the division of the family life cycle in this paper is not exactly the same: Firstly, as mentioned above, this paper focuses on the families in which the head of the household and his spouse have demonstrated reproductive behavior, and excludes the sample families without children. Secondly, in Chinese rural areas, due to the problems faced by children after marriage, such as daily family life care, childcare and the sharing of living expenses, they need expanded support from their parents, so more and more children choose not to separate from their parents. At the same time, due to the existence of family agricultural production activities, Chinese rural youth will often go home to eat with their parents even if they are separated from their parents, so their children will not be completely separated from their parents. Based on the reality of Chinese rural areas mentioned above, this paper only retains the four stages of the upbringing period, burden period, stability period and support period to divide the family life cycle of the sample farmers. The following is the impact of child rearing burden on the adoption of climate adaptive technologies in different family life cycles.

1. Upbringing period

During this time, most people have children, however, they are still very young. An increase in the number of children will simply lead to an increase in subsistence consumption, such as food. Moreover, farmers' parents are not very old, so they can help take care of their children and provide subsidies for their lives.Therefore, male farmers can have more time and energy for non-agricultural employment to increase their family income. The resulting labor shortage has become the main factor restricting the adoption of climate adaptive technologies.

2. Burden period

Most families' children have completed compulsory education and are entering high school or higher education, and education expenditures are generally higher at this stage. Moreover, farmers' parents are older and need to be supported, which will likewise increase the financial and emotional burden on the family. Therefore, at this stage, farmers will face greater economic pressure to withstand economic losses, which will lead to conservative production decisions. Thus, at this stage, the burden of raising children limits the adoption of climate adaptation technologies, with risk preference being the main influence mechanism.

3. Stable period

By this time, most children have finished school and entered the labor market to earn money. The increase in the number of children means that families have a higher income. As a result, farmers and households have more economic capital to invest in agricultural production. That is, the number of children has a significant positive effect on the adoption of climate adaptation technologies for which economic capital is the mechanism.

4. Support period

Farmers at this stage are older, resulting in poorer health and labor capacity, less frequent participation in agricultural production activities, and instead, they earn rental income from transferred farmland to support their daily lives, so the adoption of climate adaptive technologies is generally lower at this stage and the differences among farmers are not significant. Therefore, the number of children had no significant effect on the adoption of climate resilient technologies by farmers. Based on this, Hypotheses are proposed in this paper. Figure 1 represents the graphical illustration of the study.

Table 1. Division of family life cycle stages.

Phase Division	Division Basis
Initial stage	Young couple, childless
Upbringing period	Children or grandchildren are born, the youngest children or grandchildren are children or students without income and there are no elderly people over 65 years old
Burden period	Children or grandchildren are born, the youngest children or grandchildren are children or students without income and there are people over 65 years old
Stable period	The youngest child or grandson has worked and there is no elderly person over 65 years old
Alimony period	The youngest child or grandson has worked and is over 65 years old
Empty nest period	There is only one or two old people in the family who live permanently and the head of household is older than 65 years old

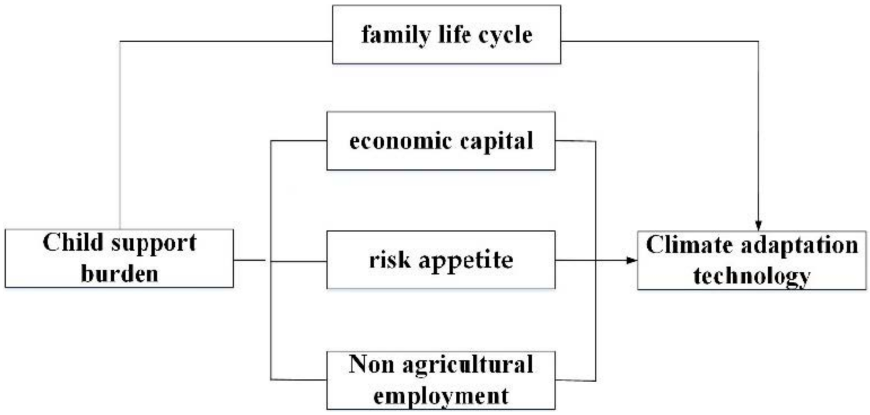

Figure 1. Technical route framework diagram.

Hypothesis 5 (H5). *In different family life cycles, the impact of child rearing burden on climate adaptation adoption is heterogeneous.*

Hypothesis 6 (H6). *During the upbringing period, the burden of child rearing has a significant negative impact on farmers' adoption of climate adaptive technology, and non-agricultural employment is its path.*

Hypothesis 7 (H7). *In the burden period, the burden of child rearing has a significant inhibitory effect on farmers' adoption of climate adaptive technology, and risk preference is its intermediate transformation path.*

Hypothesis 8 (H8). *In the stable period, the child rearing burden can significantly promote the use of climate adaptive technology by farmers and affect farmers' adoption of this technology through economic capital.*

Hypothesis 9 (H9). *During the alimony period, the number of children has no significant impact on the adoption of climate adaptive technology.*

3. Materials and Methods

3.1. Data Source

The data in this paper comes from the research carried out in the Loess Plateau in July 2017. The research sites are Dingxi City, Gansu Province, Guyuan City, Ningxia Province and Xianyang City, Shaanxi Province (as shown in Figure 2). The selection of the survey area mainly considered two factors: First, the Loess Plateau is an important grain producing area in China. Due to the intensive resource exploitation and unreasonable land use in the early stages, this area has problems such as vegetation damage and soil erosion, which has made it become one of the most vulnerable areas in China. Agricultural production is vulnerable to climate impact, especially the lack of precipitation. Second, in the consideration of research provinces, the selected provinces have the most vulnerable ecological environment in the Loess Plateau due to drought, serious soil erosion and frequent natural disasters. Selecting the above areas has high research value. In addition, in 2015, the Ningxia Autonomous Region implemented the construction project of the water-saving agriculture demonstration area. In 2016, the Shaanxi provincial government formulated policies to promote large-scale and efficient water-saving irrigation in Guanzhong and Northern Shaanxi and promote crop water-saving and drought resistance technologies. In 2017, the Gansu Province, together with the Hebei Province, the Heilongjiang Province and the seven other provinces, jointly built the "expressway" for the promotion of efficient water-saving irrigation technology. It can be seen that the selected provinces have a good policy environment to carry out the research on the adoption of climate adaptive technologies. Therefore, it is typical and representative to select farmers in this area to study the adoption of climate adaptive technology. On the basis of comprehensive consideration of geographical location and agricultural operation conditions, the research group selects two counties (districts) in each city, and then selects samples by combining stratified and level-by-level sampling and random sampling. The specific sampling process is as follows: randomly select 2–4 towns in each county, then randomly select 2 villages in each town, and finally, randomly select 10–20 farmers in each village. A total of 624 questionnaires were distributed to farmers in this survey. This paper eliminated the invalid questionnaires with serious lack of questionnaire information, inconsistent answers and abnormal values, and finally obtained 511 valid samples.

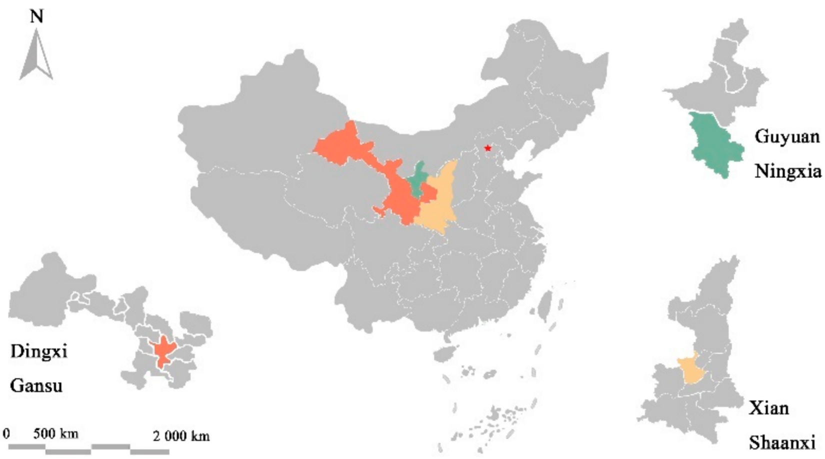

Figure 2. Sample distribution map.

3.2. Variable Measurements

Dependent Variable. Existing studies show that climate adaptation technologies include new adaptive variety technology, conservation tillage technology, improved irrigation systems, etc. [72]. Drought is the most common, widely distributed and most influential climate disaster in China, especially with the gradual northward shift of the center of gravity of Chinese grain production [73,74]. The main agricultural production areas in the north are undertaking more and more heavy grain production tasks, but the distribution of precipitation resources in this area is relatively small and the groundwater overexploitation is serious; thus, the mismatch between grain production and water resources is expanding [5], which seriously affects Chinese grain production [75]. As one of the important measures for small farmers to cope with climate change [76,77], water-saving irrigation measures can effectively ensure food security by reducing agricultural water consumption and improving water efficiency [78,79], enhancing farmers' ability to cope with arid climates. Meanwhile, water-saving irrigation technology has the same attributes as other climate adaptation technologies, such as the early required equipment investment and risk attributes mentioned in this paper. Therefore, taking the water-saving irrigation technology as an example to study the adoption of climate adaptation technologies can be popularized and replicated for the research of other climate adaptation technologies. Zaveri et al. analyzed the impact of irrigation factors and climate change on the unit yield of wheat in India and found that the use of efficient irrigation technology can offset some of the negative effects of climate change [80]. According to the technical efficiency of water-saving irrigation, it can be divided into inefficient (i.e., flood irrigation) and efficient (i.e., sprinkler irrigation and drip irrigation) [81]. When farmers choose sprinkler irrigation or drip irrigation, it is regarded as adopting water-saving irrigation technology, and the value is 1. Otherwise, the value is assigned as 0.

Core Independent Variable. The core independent variable of this paper is the number of children, that is, the total number of children in the family. The more children in the family, the heavier the burden of child support.

Intermediary Variable. This paper selects economic capital, risk appetite and non-agricultural employment as intermediary variables. Chinese residents attach great importance to savings. Household savings is not only an important indicator of social status, but also the most important source of investment capital [82]. Therefore, household savings is an important indicator of household economic capital. This paper uses household savings rate to represent economic capital variables. Most studies use participation in non-agricultural employment or the proportion of non-agricultural employment to characterize non-agricultural employment variables [83,84], but considering that the biggest goal of non-agricultural employment is to increase income, based on previous studies, we use the proportion of farmers' non-agricultural income to characterize non-agricultural employment variables [72]. As the subjective will of farmers, it is difficult to measure risk appetite directly, so it is measured by the characteristics of risk appetite displayed by farmers under the hypothetical scenario and the question, "I don't do anything risky (very agree = 1 agree = 2 general = 3 disagree = 4 very disagree = 5)", is set in the questionnaire to represent the risk appetite of farmers.

Control Variables. Based on the theory of farmers' behavior and related research, individual characteristics, family characteristics, business characteristics, cognitive characteristics and regional virtual variables are selected as control variables. Among them, four variables are selected for individual characteristics: age, health status, education status and nationality. Family characteristics include three variables: family income, cultivated land scale and whether to join the cooperative. The selection of management characteristics includes two variables: training and land transfer. The awareness of disasters was selected to represent the cognitive characteristics. The specific variable definitions and descriptive statistics are shown in Table 2.

Table 2. Variable definition and descriptive statistics.

Variable Name	Variable Description	Mean	Std. Dev
Dependent variable			
Adoption of climate adaptation technology	Whether water-saving irrigation technology is adopted? Yes = 1, no = 0	0.766	0.424
Core independent variable			
Child support burden	Number of children in the family	1.620	0.705
Intermediary variable			
Non-agricultural employment	Proportion of non-agricultural income in total income	0.580	0.280
Risk appetite	I don't do anything risky: Strongly agree = 1 Agree = 2 General = 3 Disagree = 4 Strongly disagree = 5	2.920	1.355
Economic capital	Savings rate	0.720	0.312
Control variable			
Personal characteristics			
Age of the head of household	Actual age of the head of household	52.920	9.800
Education status	Actual education years of the householder	6.500	3.572
Nationality	Other nationalities = 0, Han = 1	0.910	0.289
Health status	Very unhealthy = 1 Unhealthy = 2 General = 3 Relatively healthy = 4 Very healthy = 5	1.722	1.183

Table 2. *Cont.*

Variable Name	Variable Description	Mean	Std. Dev
Family characteristics			
Family income	Logarithm of total household income in the previous year	10.731	0.886
Cultivated land scale	Actual operating area of the family	5.840	6.033
Cooperative	Whether to join the cooperative? Yes = 1, no = 0	0.320	0.513
Operating characteristics			
Training	Whether to participate in agricultural technology training? Yes = 1, no = 0	0.370	0.483
Land Transfer	Whether the land is transferred? Yes = 1, no = 0	0.270	0.442
Cognitive characteristics			
Awareness of disasters	Very ignorant = 1 Don't understand = 2 General = 3 Understanding = 4 Very familiar = 5	0.900	0.302
Regional control variables	Shaanxi = 1, Gansu = 2, Ningxia = 3	1.944	0.809

3.3. Research Methods

The adoption of climate adaptation technology is a binary discrete selection problem. Therefore, we established a binary discrete choice Probit model to analyze the relationship between child rearing burden and climate adaptive technology adoption. The Probit model, set as Y_i, can be derived from the latent variable model. Assuming that there is an unobservable latent variable Y*, it meets the following requirements:

$$Y_i = \beta X_i + \varepsilon_i \text{ i} = 1, 2, \ldots, \text{N} \tag{1}$$

The observed variable is determined by whether the latent variable exceeds the threshold value. If > 0, it means that farmers adopt climate adaptation technology in agricultural production. On the contrary, if Y_i = 0, it means that farmers do not adopt the technology. Then the Probit model of farmers' adoption of climate adaptation technology can be expressed as:

$$\text{P} = \text{Pr}ob(Y = 1/X = x) = \text{Pr}ob(Y^* > 0/X) = \text{Pr}ob\{(\varepsilon_i > -x_i\beta)/x\} = \Phi(x_i\beta) \tag{2}$$

where X is the actual observed variable, which represents various factors affecting the adoption of the technology by farmers. It is a random disturbance term and follows the standard normal distribution; it is the standard normal cumulative distribution function. In the above models, the dependent variables are valued from 0–1 and are discontinuous binary variables. The more common method is to use binary selection models such as Probit and Logit for analysis. There is no significant difference in the estimation results between the two methods. The difference between the two regression models lies in the different distribution functions. The Probit model assumes that random variables obey a normal distribution, while the Logit model assumes that random variables obey a logical probability distribution. This paper selects a Probit model for the empirical analysis and a Logit model for the stability test.

Second, as is shown in Figure 3, this paper used the intermediary effect test model to investigate the mechanism of the number of children affecting farmers' climate adaptation technology. Firstly, according to the theoretical analysis, the transmission mechanism variables and the number of children are introduced to test the impact of the number of children on non-agricultural employment, risk appetite and economic capital. Secondly, it tests the impact of non-agricultural employment, risk appetite and economic capital on farmers' adoption of climate adaptation technology. The specific regression model is as follows:

$$Y = \theta_1 + cX_i + \delta Z_i + \varepsilon_1 \quad (3)$$

$$M_i = \theta_2 + aX_i + \delta Z_i + \varepsilon_2 \quad (4)$$

$$Y = \theta_3 + c' X_i + bM_i \delta Z_i + \varepsilon_3 \quad (5)$$

where Y is whether the explained quantity adopts climate adaptation technology, the independent variable X_i is the number of children, Z_i is each control variable and Mi is the transmission variable of non-agricultural employment, risk appetite and economic capital, respectively. a, b, c and c' are regression coefficients. When the coefficients a, b and c in the model are significant, there is an intermediary effect. If the coefficient to be estimated c is significant and at least one of a and b is not significant, a further Sobel test needs to be carried out. When there is an intermediary effect, if c is not significant, it is a complete intermediary effect; otherwise, it is a partial intermediary effect.

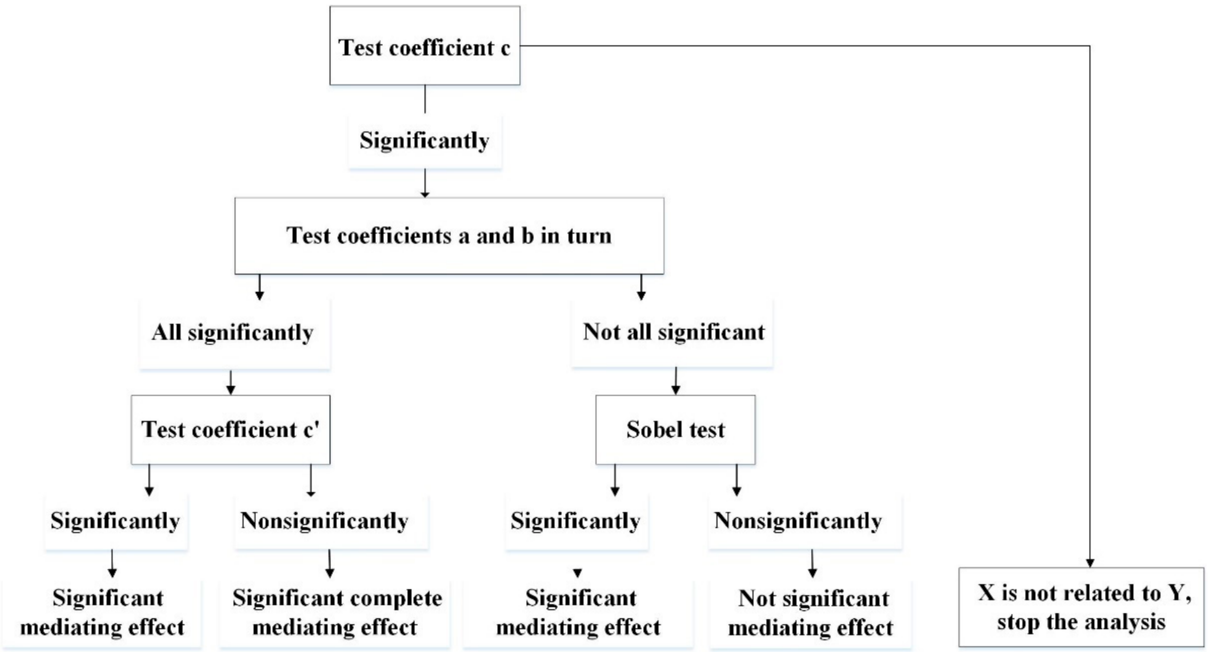

Figure 3. Mediating effect test procedure.

4. Results

4.1. Result Analysis of the Impact of the Number of Children on Farmers' Adoption of Climate Adaptive Technology

In this paper, we find that there may be multicollinearity among multiple variables. Firstly, we test the multicollinearity of each variable. The results show that the maximum variance expansion factor is 1.311 and the mean value is 1.018. Therefore, it can be considered that there is no multicollinearity in the independent variable in this paper.

Table 3 reports the results of benchmark regression (in addition to the Probit model and the Logit model). According to the results of model 1, the number of children has a significant negative impact on the adoption of climate adaptation technology by farmers and passes the test of 1% significance level. It shows that the more children in farmers' families, the lower the possibility of adopting climate adaptation technology in agricultural production. In other words, the number of children has a significant inhibitory effect on the use of climate adaptation technology. It should be noted that since farmers' fertility behavior is mainly determined by the external environment such as the timing of marriage and childbearing, family economic capital and fertility policies, the adoption of climate adaptive technologies as a production decision is not sufficient to affect farmers' fertility in turn, so the number of children farmers have can be considered as an exogenous variable for the adoption of climate adaptive technologies; that is, the endogenous problem of the number of children does not need to be considered.

Table 3. Estimation results of the impact of the number of children on the adoption of soil and water conservation technologies by farmers.

	Model 1 (Probit)		**Model 2 (Logit)**	
	Coef.	**Std. E**	**Coef.**	**Std. E**
Number of children	−0.249 **	(0.102)	−0.410 **	(0.173)
Age	−0.002	(0.007)	−0.004	(0.011)
Education status	0.094 ***	(0.018)	0.161 ***	(0.031)
Nationality	−0.245	(0.249)	−0.370	(0.431)
Health status	0.244 ***	(0.063)	0.432 ***	(0.113)
Family income	0.018	(0.067)	0.048	(0.112)
Cultivated land scale	0.034 **	(0.013)	0.058 **	(0.024)
Cooperative	0.216	(0.161)	0.387	(0.293)
Training	−0.215	(0.136)	−0.384	(0.237)
Land transfer	−0.147	(0.144)	−0.283	(0.247)
Awareness of disasters	0.361 *	(0.201)	0.622 *	(0.337)
Region	0.010	(0.093)	0.037	(0.162)
Constant term	−0.157	(0.953)	−0.157	(1.603)
Prob >chi2	0.000		0.000	
Pseudo R2	0.138		0.130	
Sample capacity	511		511	

Note: ***, ** and * represent significance levels of 1%, 5% and 10% (double tails), respectively. The values in brackets are robust standard errors.

Among the control variables, education status has a significant positive role in promoting farmers' use of climate adaptive technology. The reason for this is that a higher level of education helps to broaden farmers' vision and improve farmers' ability to master and apply climate adaptive technologies, so as to promote farmers' adoption of climate adaptive technologies. Health status has a significant positive impact on farmers' adoption of climate adaptive technology. The reason for this is that with the improvement of health status, farmers will have more energy and physical strength to learn climate adaptive technology, which will improve the effect of learning and promote the use of climate adaptive technology. The cultivated land scale has a significant positive role in promoting farmers' climate adaptive technology. The reason for this is that the larger the cultivated land scale in farmers' families, the higher the potential agricultural production income, so farmers will have the motivation to adopt climate adaptive technology. The awareness of disasters has a significant positive role in promoting the use of climate adaptive technology by farmers. Farmers with a high degree of disaster awareness are able to precisely recognize the losses to agricultural production caused by disasters, and thus, promote the adoption of climate resilient technologies by farmers.

4.2. Robustness Test: Change of Estimation Method

This paper retests the relationship between the number of children and climate adaptive technology by using the propensity score matching method (PSM). Table 4 reports the robustness test of the impact of farmers' adoption of child support burden on farmers' adoption of climate adaptive technologies.Firstly, the one-child family is taken as the control group and the samples of two or more children in the family is taken as the treatment group based on income, cultivated land scale, decision to join the cooperative, age, education status, nationality, health status, awareness of disasters, training and land transfer. The Logit score of each sample was calculated as the explanatory variable. Secondly, taking the sample of the one-child family as the control group and the sample of the multi-child family as the treatment group, three methods are selected for matching (close neighbor matching, caliper matching and kernel matching). The results of the parallelism test show that the standard deviation of most covariates before and after matching is within 10% and the *t*-test results of all covariates after matching do not reject the original hypothesis; that is, there is no significant difference in matching variables between the treatment group and the control group, indicating that the matching result is good and passed the parallelism test. In the PSM estimation results, the average treatment effects of k-nearest neighbor matching, kernel matching and caliper matching are −0.095, −0.091 and −0.095, respectively, indicating that the use of climate adaptive technology in multi-child families is 9.367 percentage points lower than that in one-child families. In short, the matching result of the propensity score is highly consistent with the above regression conclusion. Families with more children will use less climate adaptive technology in agricultural production, which shows that the impact of the number of children on farmers' climate adaptive technology has passed the robustness test.

Table 4. Re-estimation of climate adaptive technology selection under different number of children.

	Matching Method	Only Child Family	Families with Many Children	Average Treatment Effect
Whether to adopt climate adaptive technology	K-nearest neighbor matching	0.786	0.691	−0.095 *
	Kernel matching	0.782	0.691	−0.091 **
	Caliper matching	0.789	0.694	−0.095 *

Note: ** and * represent significance levels of 1%, 5% and 10% (double tails), respectively. The values in brackets are robust standard errors.

4.3. Intermediary Mechanism Test

4.3.1. The Intermediary Effect Test of Risk Appetite

Table 5 shows the effect mechanism test of the number of children on the adoption of climate adaptive technology by farmers. Firstly, the results of model 1 show that the number of children has a direct impact on the use of climate adaptive technology by farmers and the estimated coefficient is −0.249, indicating that the number of children has a significant negative impact on the adoption of climate adaptive technology by farmers. Secondly, according to the results of model 3, the influence coefficient of the number of children on risk appetite is significantly negative, indicating that the more children in the family, the more farmers tend to avoid risk in agricultural production. Thirdly, after controlling for the number of children, the intermediary variable of risk appetite still plays a significant role in promoting the adoption of climate adaptive technology. Based on the above empirical results, the intermediary effect of risk appetite between the number of children and the use of climate adaptive technology exists and it is part of the intermediary effect, accounting for 19.1% of the total effect. This shows that 19.1% of the impact of the number of children on farmers' adoption of climate adaptive technologies should be realized through the intermediary role of risk appetite, which proves that the increase in the number of children reduces the degree of farmers' risk preference, thus inhibiting farmers' adoption of climate adaptive technologies. Risk appetite also proved to be an intermediate transformation path between the number of children and the adoption of climate adaptive technology. Hypothesis 2 is proved.

Table 5. Effect mechanism test of the number of children on the adoption of climate adaptive technology by farmers.

	Model 3		Model 4		Model 5	
	Risk Appetite	Climate Adaptation Technology	Economic Capital	Climate Adaptation Technology	Non-Agricultural Employment	Climate Adaptation Technology
Number of children	−0.264 *** (0.070)	−0.189 * (0.105)	−0.058 *** (0.022)	−0.224 ** (0.104)	0.147 *** (0.015)	−0.190 * (0.108)

Table 5. *Cont.*

	Model 3		Model 4		Model 5	
	Risk Appetite	**Climate Adaptation Technology**	**Economic Capital**	**Climate Adaptation Technology**	**Non-Agricultural Employment**	**Climate Adaptation Technology**
Risk appetite		0.180 *** (0.053)				
Economic capital				0.481 ** (0.196)		
Non-agricultural employment						−0.450 * (0.268)
Other variables	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
Prob >chi2	0.000	0.000	0.000	0.000	0.000	0.000
Pseudo R2	0.013	0.154	0.114	0.141	0.223	0.136
Sample capacity	511	511	511	511	511	511

Note: ***, ** and * represent significance levels of 1%, 5% and 10% (double tails), respectively. The values in brackets are robust standard errors.

4.3.2. The Intermediary Effect Test of Economic Capital

Firstly, according to the estimation results of model 4, the influence coefficient of the number of children on economic capital is negative and passed the 1% significance level test, indicating that the number of children in farmers' families significantly reduces economic capital. Secondly, after controlling for the effect of the number of children, economic capital still plays a significant role in promoting the use of farmers' climate adaptive technology. Therefore, according to the judgment method of intermediary effect, the intermediary effect of economic capital between the number of children and the adoption of climate adaptive technology exists, which is also part of the intermediary effect. After the calculation, the intermediary effect accounts for 11.2% of the total effect, which shows that 11.2% of the impact of the number of children on farmers' adoption of climate adaptive technology is realized through the intermediary effect of economic capital variables; that is, the number of children reduces the economic capital in farmers' families, thus reducing farmers' adoption of climate adaptive technology. Hypothesis 3 is proved.

4.3.3. The Intermediary Effect Test of Non-Agricultural Employment

According to the results of model 5, the number of children has a positive impact on farmers' non-agricultural employment and passed the 1% significance level test, indicating that the number of children promotes farmers' non-agricultural employment. In addition, the number of children and non-agricultural employment passed the 10% significance level test and the non-agricultural employment coefficient is negative. Therefore, from the estimated value and significance of each variable parameter, the intermediary effect of non-agricultural employment exists, but it is part of the intermediary effect and the intermediary effect accounts for 24.4% of the total effect. This shows that about 24.4% of the impact of the number of children on the adoption of climate adaptive technologies is realized through the intermediary effect of non-agricultural employment variables; that is, the number of children affects the adoption of climate adaptive technologies by changing farmers' non-agricultural employment. This result verifies the existence of the non-agricultural employment path and hypothesis 4 is proved.

In summary, the mechanisms of risk appetite, economic capital and non-agricultural employment on the effect of child support burden on the adoption of adaptive technologies by farm households were all verified, with non-agricultural employment playing a greater role, followed by risk appetite and finally, economic capital.

4.4. Heterogeneity Test Based on Family Life Cycle

Table 6 shows the test of the influence of the number of children on the adoption of climate adaptive technology and its mechanism test in upbringing period. According to the results of model 6, the number of children has a significant negative impact on farmers' adoption of climate adaptive technology in the upbringing period, which shows that the increase in the number of children hinders farmers' use of climate adaptive technology in this period. In the impact mechanism test, the results of model 7 show that the non-agricultural employment path has passed the significance test and the intermediary effect value is −1.004, accounting for 87.4% of the total effect value, indicating that the number of children has an inhibitory effect on the adoption of climate adaptive technologies by increasing non-agricultural employment. The intermediary effect of economic capital and risk appetite is not significant. The reason for this is that during the upbringing period, farmers' parents are not old enough to need support and only their children need care. Therefore, at this stage, families often decide to leave women at home to take care of their children, while the male labor force, with more time and abundant physical strength, will consider non-agricultural employment to increase family income, which directly reduces the labor supply in agricultural production and forms labor supply constraints. This has an impact on the adoption of climate adaptive technologies. Therefore, during the upbringing period, non-agricultural employment has become an important factor affecting farmers' adoption of climate adaptive technologies.

Table 6. Test of influencing factors and action mechanism of farmers' climate adaptive technology in upbringing period.

	Model 6	**Model 7**		**Model 8**		**Model 9**	
	Climate Adaptation Technology	**Non-Agricultural Employment**	**Climate Adaptation Technology**	**Economic Capital**	**Climate Adaptation Technology**	**Risk Appetite**	**Climate Adaptation Technology**
Number of children	−1.149 ** (0.474)	0.618 *** (0.238)	−0.894 * (0.500)	−0.070 (0.055)	−1.146 ** (0.491)	−0.520 ** (0.254)	−1.014 ** (0.485)
Non-agricultural employment			−1.625 * (0.801)				
Economic capital			-		0.021 (1.067)		
Risk appetite							0.177 (0.154)
Other variables	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
Prob >chi2/F	0.004	0.047	0.001	0.001	0.006	0.040	0.031
Pseudo R2	0.369	0.036	0.424	0.332	0.369	0.050	0.387
Sample capacity	69	69		69		69	

Note: ***, ** and * represent significance levels of 1%, 5% and 10% (double tails), respectively. The values in brackets are robust standard errors.

Table 7 shows the test of the influence of the number of children on the adoption of climate adaptive technology and its mechanism test in burden period. According to the results of model 10, in the burden period, the number of children has a significant inhibitory effect on the use of climate adaptive technology. In the test of impact mechanism, it can be seen from model 13 that the number of children has a significant negative impact on risk appetite and risk appetite has a significant positive impact on the use of climate adaptive technology, indicating that risk appetite has a significant intermediary effect between the number of children and the use of climate adaptive technology. The intermediary effect value is −0.044, accounting for 15.8% of the total effect. It can be seen that the impact of the number of children on climate adaptive technology adoption in the burden period mainly depends on the path of risk appetite. The reason for this is that in the burden period, farmers need to support both the elderly and the minor children, which further aggravates the economic burden and increases the survival pressure of farmers, which will increase the degree of risk aversion of farmers. Therefore, risk appetite has become the main path for the number of children to affect the adoption of climate adaptive technology in this period.

Table 7. Test of influencing factors and action mechanism of farmers' climate adaptive technology in burden period.

	Model 10	Model 11		Model 12		Model 13	
	Climate Adaptation Technology	**Non-Agricultural Employment**	**Climate Adaptation Technology**	**Economic Capital**	**Climate Adaptation Technology**	**Risk Appetite**	**Climate Adaptation Technology**
Number of children	−0.434 ** (0.175)	0.120 *** (0.029)	−0.353 * (0.183)	−0.151 *** (0.026)	−0.402 ** (0.190)	−0.277 ** (0.127)	−0.387 ** (0.178)
Non-agricultural employment			−0.816 (0.508)				
Economic capital					0.203 (0.445)		
Risk appetite							0.158 * (0.083)
Other variables	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
Prob >chi2	0.001	0.000	0.000	0.000	0.002	0.000	0.001
Pseudo R2	0.184	0.219	0.197	0.266	0.185	0.02	0.202
Sample capacity	201	201		201		201	

Note: ***, ** and * represent significance levels of 1%, 5% and 10% (double tails), respectively. The values in brackets are robust standard errors.

Table 8 shows the test of the influence of the number of children on the adoption of climate adaptive technology and its mechanism test in stable period. According to the results of model 14, different from other family life cycle stages, the number of children in the stable period has a significant positive impact on the use of climate adaptive technology, indicating that the more children in farmers' families in this period, the more inclined they are to adopt climate adaptive technology. In the test of impact mechanism, the results of model 16 show that the number of children has a significant positive impact on economic capital and economic capital has a significant promoting effect on the use of climate adaptive technology, which shows that economic capital has a significant positive intermediary effect between the number of children and the use of climate adaptive technology. Economic capital is the path through which the number of children affects the adoption of climate adaptive technology in this stage and the intermediary effect value is 0.127, accounting for 23.1% of the total effect. The reason for this is that in the stable period, farmers have no maintenance costs and their children have started to work, which not only reduces the maintenance cost, but also obtains subsidies from their children. Therefore, in this period, the economic capital of farmers with more children will be relatively high and the economic capital can promote the adoption of climate adaptive technologies. Therefore, the increase in the number of children significantly improves the economic capital and then promotes the use of climate adaptive technologies by farmers.

During the alimony period, the relationship between the number of children and the adoption of climate adaptive technology did not pass the significance test. The possible reason for this is that at this stage, farmers are older, resulting in poor health and labor ability and the frequency of participation in agricultural production activities is reduced. Instead, they maintain their daily life by obtaining rental income from transferred farmland. Therefore, farmers at this stage generally have a low degree of adoption of climate adaptive technology, such that the differences in climate adaptation adoption behavior among farmers were not significant enough to identify the effects of the explanatory variables, which may be the reason why the number of children has no significant impact on the adoption of climate adaptive technology. In addition, because the number of children has no significant impact on the adoption of climate adaptive technology, there is no need to test the mediating effect.

Table 8. Test of influencing factors and action mechanism of farmers' climate adaptive technology in stable period.

	Model 14	Model 15		Model 16		Model 17	
	Climate Adaptation Technology	**Non-Agricultural Employment**	**Climate Adaptation Technology**	**Economic Capital**	**Climate Adaptation Technology**	**Risk Appetite**	**Climate Adaptation Technology**
Number of children	0.550 ** (0.266)	0.139 *** (0.038)	0.545 (0.299)	0.129 ** (0.048)	0.488 * 0.277	0.006 (0.181)	0.595 *** (0.174)
Non-agricultural employment			0.033 (0.835)				
Economic capital			-		0.986 * (0.529)		
Risk appetite							0.536 *** (0.174)
Other variables	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
Pseudo R2	0.279	0.278	0.279	0.095	0.316	0.038	0.407
Sample capacity	70	70		70		70	

Note: ***, ** and * represent significance levels of 1%, 5% and 10% (double tails), respectively. The values in brackets are robust standard errors.

5. Discussion

Based on data from 511 household surveys, this paper used a Probit model to explore the impact of child rearing burden on farmers' adoption of climate adaptation technology, then analyzed its mechanism through an intermediary effect model and discussed its heterogeneity based on the family life cycle theory. The results have shown that: Firstly, the child rearing burden has a significant negative impact on farmers' climate adaptive technology adoption and the results are still robust even if the model is replaced, which is similar to the conclusion that the burden effect hinders the progress of agricultural technology [85]. Secondly, the impact mechanism analysis has shown that the child rearing burden mainly affects farmers' adoption of climate adaptive technologies through three paths: risk appetite, economic capital and non-agricultural employment. These findings are consistent with the mechanism of child support burden studied in other areas of individual behavioral decision-making [86–88]. Among them, non-agricultural employment plays the largest role, followed by risk preference, and finally, economic capital. Thirdly, the heterogeneity analysis has shown that there are differences in the impact and path of the number of children on farmers' climate adaptive technology adoption in different family life cycles. The finding is consistent with the conclusion that farmers' behavior is heterogeneous in different family life cycles [89,90]. During the upbringing period, the number of children has a significant negative impact on the adoption of climate adaptive technology and non-agricultural employment is its path. In the burden period, the number of children has a significant inhibitory effect on the adoption of climate adaptive technology and risk preference is the intermediate transformation path. In the stable period, the number of children can significantly promote the use of climate adaptive technology and the number of children has an impact on the adoption of climate adaptive technology through economic capital.

According to the research results of this paper, the implications are as follows:

First, as far as the government is concerned, it should further promote the reform and improvement of the rural social security system, so as to improve the level of rural social security and effectively solve farmers' childbirth worries. It is also necessary to fully understand the characteristics of farmers' risk preference in agricultural production and formulate differentiated insurance policies according to the characteristics of different farmers to help them effectively avoid the risks of technology adoption. Besides, the government must also encourage farmers to invest their non-agricultural income in the adoption of climate adaptive technologies through measures such as raising crop prices and improving traffic conditions, so as to reduce the labor constraints caused by non-agricultural employment on the adoption of climate adaptive technologies.

Second, the advanced management concepts and agricultural production technologies brought by agricultural enterprises will have a far-reaching impact on farmers' agricultural production. Therefore, agricultural enterprises should increase investment in the research and development of climate adaptive technologies to reduce the cost of farmers' adoption of new technologies, so as to alleviate the restraining effect of the childcare burden on the technology adoption. In addition, education and training opportunities should be provided for farmers to reduce their learning costs, in order to encourage farmers to adopt technologies to adapt to climate change.

Third, as an agricultural production organization with Chinese characteristics, cooperatives play an important role in promoting agricultural production. Therefore, promoting farmers' adoption of climate adaptive technologies cannot ignore the role of this organization. Cooperatives should increase publicity and training on climate adaptive technologies to reduce the degree of information asymmetry and improve farmers' risk perception of the technologies, in order to promote the adoption of the technologies. Cooperatives should further play the role of bridging farmers and the external environment and organizing experts and enterprise technicians to communicate with farmers to reduce the learning cost so that the latest technological achievements can be quickly transferred to farmers.

Fourth, based on the findings of this paper, it is clear that farmers' agricultural production behavior is a complex issue that is not only limited by household economic capital, but also influenced by psychological factors and the surrounding environment. Most previous studies on farmers' production behavior have mostly been conducted from a single perspective, which obviously does not address this issue well. Therefore, scholars from different academic backgrounds, such as sociology, psychology and economics, need to consciously seek interdisciplinary and cross-disciplinary communication and cooperation to jointly address the issue of farmers' climate adaptive technology adoption.

The present study has several limitations. First, the research samples in this study come from the Loess Plateau area in the Shanxi, Ningxia and Gansu provinces, but not all of the Loess Plateau area is in China. Therefore, in the future, subsequent research needs to expand the scope of the sample further to improve the applicability of the research conclusions. Second, through the survey, we obtained the adoption of climate adaptive technology by farmers in 2017, but the actual adoption time of farmers may be earlier than 2017. Therefore, the family circumstances we obtained in the survey process is different from that of farmers when they adopted the technology, which may cause measurement errors. However, as introduced in the data source section, with the support of policies, Ningxia, Shaanxi and Gansu have promoted water-saving irrigation technology on a large scale in 2015, 2016 and 2017, which is not a long time before we obtained the research report. Therefore, we believe that although there are errors in the research, the errors are small, which is not enough to overturn our conclusion. In order to make the research conclusion more accurate and minimize the impact of the above problems as much as possible, some improvements will be made in future research: we will continue to improve this area of research by conducting multi-stage research in the Loess Plateau to form panel data, so as to capture the dynamic changes of farmers' adoption of climate adaptive technology. Besides, in the process of research, it is necessary to clarify the specific time needed for farmers to adopt climate adaptive technologies in order to avoid the above problems. Finally, due to data limitations, this paper only focuses on the impact of child support burden on whether farmers adopt the technology. In fact, for farmers who have adopted this technology, the child support burden will also have an impact on the amount of investment in climate adaptive technology. Therefore, in future research, we will focus on the intensity of farmers' adoption of climate adaptive technologies.

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