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Ecological aspiration and the income of farmers aroused by Grain for Green Project

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For farmers, the more fragile the state of the ecology becomes, the more their awareness of the need for environmental protection grows. China's Grain for Green Project (G.G.P.) policy of returning farmland to forests and grassland, as an external shock to the environment, has sparked people's ecological aspirations. Many people have noticed the phenomenon of ecosystem degradation and overlapping poverty. Analyzing the environmental and income changes brought about by the G.G.P., and this study considers farmers' self-selection problems due to their lack of subjective thinking regarding this initiative. Our study aims to fill this gap by using a forest–grass model to assess the level of farmers' ecological aspirations in ecologically vulnerable areas of Xinjiang, China. This article is based on aspiration theory and a theoretical model assessing the economic impact of ecological aspiration on the G.G.P. in China. The results show that farmers' ecological aspirations can increase their enthusiasm to participate in the G.G.P. Under counterfactual conditions, participation in the G.G.P. initially reduces farmers' total income to a certain extent; however, in the long run, it can significantly increase the total income of farmers. When the intermediary effect is used to analyze the economic effect of ecological aspiration on returning farmland to forest, it is found that farmers' ecological aspirations affect household income by influencing income expectations. Our findings have essential practical implications and provide an important reference for consolidating poverty alleviation efforts and effectively promoting rural revitalization. In addition, the results suggest a way to achieve the goals of carbon peak and carbon neutrality, and it is necessary for building environmental-friendly regions.

KEYWORDS

ecological aspiration, Grain for Green Project, economic effect, forest-grass model, rural household

Introduction

Thus far, the Grain for Green Project (G.G.P.) is an important measure for countries around the world to build an ecological environment and adapt to climate change. Its coverage, audience, investment scale, and participation by the masses have led it to become the largest project in the history of ecological forestry construction. The research of new institutional economics shows that the motivation of production and daily life in human society is dual, pursuing the maximization of wealth and the maximization of non-wealth[1] (Brownson et al., 2020). According to the results of G.G.P. – returning farmland to forests and grassland in China – for more than 20 years, farmers are the direct participants and the first executors of the project, whose initiative directly determine the effect of the project. In theory, although the conversion of farmland to forest may reduce household wealth accumulation, it will produce certain ecological benefits and affect farmers' ecological awareness. Therefore, increasing attention has been given to creating an effective trade-off between family wealth accumulation and environmental benefits. In recent years, throughout the promotion of G.G.P., it has been realized that the critical element for the sustainability of returning farmland to forest is the intrinsic motivation for ecological protection after compensation for this project for farmers (Bocci and Mishra, 2021; Sun and Li, 2021; Yang et al., 2021). It is in this process that ecological aspiration is produced and formed.

In recent years, global warming and the deterioration of the ecological environment have become threats and challenges to the survival of the human race. Therefore, the acquisition of ecological wealth has become essential to meet material needs. For an ecological civilization, policies for G.G.P. are important for implementing the government's theory of the "two mountains." Only by integrating the construction of an ecological civilization with precise poverty alleviation and stimulating the inherent aspiration of farmers for ecological civilization, the ecological environment and family income in ecologically fragile areas can be increased simultaneously. In March 2021, at the annual session of the National People's Congress, the Chinese government, for the first time, stated that it would meet its ambitious strategic goal of achieving a "carbon peak" and "carbon neutrality"; China would not increase its carbon dioxide emissions until 2030, gradually reducing CO_2 emissions after the peak[2]. Indeed, the ecological benefits of G.G.P. are needed to address global production and life-threatening greenhouse gases.

Ecological aspiration is a subjective attitude held by a decision-maker resulting from the "satisfaction" of the surrounding environment or the continued satisfaction once the surrounding environment has exceeded the decision-maker's initial level of desire; the level of aspiration can be measured by the degree of satisfaction of the decision-maker (Duan et al., 2021). Using this concept for reference, we believe that ecological aspiration is people's desire for an ecological environment or satisfaction with the ecological environment. It represents people's positive desires for ecological environment improvements, especially in arid areas with fragile ecological environments and poor climate conditions. People hope to improve the natural conditions of their living environment through ecological behaviors. When farmers desire to improve the ecological environment, they will take the initiative to invest, through participation, in the conversion of farmland to forests to realize the sustainable improvement in the surrounding environment. However, farmers' ecological aspirations must be guaranteed by a reasonable income before they can act on their aspirations. Future support for maintenance costs in the later period of G.G.P. is pivotal for converting ecological aspiration into practice. This support can stimulate farmers' ecological aspirations, promote farmers' rational investments in the ecological environment in ecologically fragile areas, and provide a lasting impetus to improve the environment. In fact, from the perspective of the economic forest and grass model, returning farmland to forest is an economic investment behavior. If properly applied, it can promote the improvement of the ecological environment and form good water-saving habits, thereby conserving water resources and increasing household income.

Farmers' behaviors for G.G.P., when motivated by ecological aspiration, include multistage decision-making, which is based on income expectations. At present, in studies regarding this project, most scholars have intensely discussed the subjective of farmers' will to return farmland to forest; however, an analysis of expectations is very deficient; that is, the effect of income on farmers' multistage decision-making has not been analyzed. Ecological aspiration initiatives and economic incentives are inseparable and should not be ignored by the decision-making process regarding returning farmland to the forest with the implementation of G.G.P. in 1999. Just how to stimulate farmers' ecological aspirations and increase their income by returning farmland to the forest demands a reasonable answer from an economic point of view. Therefore, this article uses Xinjiang's economic forest and grass model as an example. According to the idea of "ecological aspiration → whether to return

1 Non-wealth here mainly refers to ecological benefits other than economic effects, including beautifying the environment, preventing wind and sand erosion, conserving water sources, and protecting biodiversity. The economic effect referred to in this article is the change in farmers' family income brought by returning farmland to the forest, that is, the impact of farmers' participation in returning farmland to the forest on family income.

2 The strategic goal of "carbon neutrality" requires all units, organizations, and individuals to measure greenhouse gas emissions, offset their carbon dioxide emissions through afforestation, energy conservation, and emission reduction, and then achieve "zero emissions."

farmland → retired farmland area → income effect," it is of great significance to study the income effect of farmers returning farmland to forest.

Literature review and theoretical analysis

Literature review

In recent years, many scholars have studied the relationship between ecology and subjective aspiration, but they have focused predominantly on the analysis of ecological cognition and individuals will (Simon, 1955; Shang and Su, 2012); there are few studies on ecological aspiration from an economics perspective. A review of the literature uncovers a rich discussion of farmers' active participation in G.G.P. We focus on the following aspects:

(1) Under the premise of ecological cognition, our question is in regard to the incentives and motivations for farmers to either resume farming or continue participating in the later period of returning farmland to the forest. During the project's first phase, the government adopted a top-down approach that resulted in extensive management, inadequate consultation, and little consideration of farmers' wishes (Bennett, 2008; Kasymov et al., 2022). The lack of unity of purpose between the farmers and the government led to a significant reduction in the efficiency of the whole project (Song et al., 2014). In the second phase of the project, farmers are expected to consider ecological reasons, such as the safety of farmland production when informed about the possibility of receiving state subsidies for returning farmland to forests. These considerations can induce farmers to participate in the initiative (Song et al., 2014). In theory, if, after farmland conversion, farmers face difficulties in relocating the family's surplus labor force, their willingness to resume farming will increase. If income changes, the economic benefits of tree species and non-agricultural skills will significantly affect their willingness to resume farming (Fan and Xiao, 2020). For farmers returning farmland to the forest, both their levels of understanding and participation directly and indirectly affect their levels of satisfaction (Bi et al., 2021).

(2) Grain production in green projects alleviates poverty and increases rural household income. There are pronounced regional differences regarding how the G.G.P. subsidy affects income (Uchida and Rozelle, 2005) resulting from the different standards of the G.G.P. subsidy in the north and the south and the different economic development levels in the east, middle, and west (Hou et al., 2016). Additionally, the direct and indirect effects of returning farmland to the forest increase farmers' income. The direct effect mainly results from the government's subsidy for returning cultivated land. The indirect effect mainly results from reducing household cultivated land area and redistributing labor resources. The impact of redistributing labor resources (that is, through non-farm work) on farmers' income is more important than reducing household arable land. The ability of farmers to increase their income is intrinsic to successfully returning farmland to the forest (Wang et al., 2020). There are still significant differences in poverty alleviation and income growth. Some scholars believe that the G.G.P. will reduce the household income of farmers (Hou et al., 2016; Treacy et al., 2018; Wang et al., 2020); others believe that the G.G.P. will increase the household income of farmers (Treacy et al., 2018; Wang et al., 2020) or that there is an inverted "U" relationship between the G.G.P. and the household income of farmers. The impact of G.G.P. on farmers' household income is relatively complex. The conversion of farmland to forests will increase the income inequality of farmers (Duan et al., 2021). Sustainability depends mainly on the ability of non-farm workers to improve and diversify their income (Treacy et al., 2018).

(3) The sustainability of G.G.P. relies on the improvement of the eco-regional environment. On the one hand, significant changes have occurred in the land-use types converted since the implementation of the project. With grassland degradation significantly reduced and landscape connectivity and vegetation coverage significantly increased, the total value of ecosystem services has also increased significantly (Cao et al., 2010; Heilmayr and Lambin, 2016; Wang et al., 2020); on the other hand, the G.G.P. has not only improved the ecological environment but also improved household management structure and promoted non-agricultural employment of the workforce (Agrawal et al., 2008). A set of data shows that the return of farmland to the forest is related to the slope gradient, traffic, and income of farmers. Among the returned cropland, 81.47% of the sloping land is 25–30 degrees, 56.37% of the sloping ground is within 2 km of the road, and a higher percentage of land has been converted in regions with lower household incomes (Karanth et al., 2008). In addition, to balance the relationship between environmental protection and economic development, it has been suggested that the program of land conversion be further planned and perfected by comparing the net benefits between fruit and vegetable gardens and natural conservation forests (Zhang et al., 2000; Chandio et al., 2013; Bruggeman et al., 2015; Dupin et al., 2018; Rezende et al., 2018).

(4) The influence of aspiration on human behavior must be considered. Research on the effect of aspiration on human behavior has made some progress. In theory, on the one hand, aspiration, unlike belief, preference, and expectation, is more oriented toward the future,

prompting an individual to devote a certain amount of money, time, and energy to the achieve the goal (Beach et al., 2005); on the other hand, aspiration is an individual's meta-ability to explore the future and navigate based on the present, which influences future decision-making behavior (Beach et al., 2005). Caldas et al. (2016) systematically analyzed the relationship between aspiration and rural household income and considered that the low-income population could be divided into a high aspiration group and a low aspiration group; this study refers blood transfusion and hematopoiesis, respectively, for its methods. Aspiration mainly comes from four aspects: individual social comparison, personal-aspiration adaptation, self-efficacy, and locus of control. Based on the research, this article believes that the G.G.P. represents a new management model for economic and ecological goals. Therefore, the aspiration of farmers in ecologically fragile areas includes not only the economic aspiration for daily agricultural production and management but also ecological aspiration, which can be subdivided into regional ecological environment comparison, self-evaluation of ecological behavior, self-perception in comparison with neighbors, and expectation of future ecological behavior.

There are many studies on the willingness to G.G.P. and the income generated by doing so. However, there are still some deficiencies. First, studies on the willingness of farmers to return farmland to the forest focus only on analyzing their drive to meet income targets. Not only do these studies fail to analyze the internal driving force of farmers' ecological aspirations but they also ignore the internal logic of farmers' decision-making regarding returning farmland to forests from an economic perspective; most studies assume that farmers' decision-making on returning farmland to forest is based on passive acceptance, that is, "being pushed by the government." Once the green subsidy for grain ends, farmers will have a tendency and inclination to resume farming. This "evil nature theory" cannot accurately identify the initiatives of farmers to improve their ecological environments, creating challenges for adapting the new round of the G.G.P. to farmers' motivations; according to the analysis of the income effect resulting from returning farmland to forest, farmers' expectations regarding future income have not been considered or addressed. The relationship between future family income and actual income cannot be ignored.

Theoretical analysis and hypothesis

Duan et al. (2021) discussed the connotation and relationship between ecological cognition and ecological aspiration and pointed out that ecological cognition is the basic premise of ecological aspiration. Ecological aspiration is people's aspiration for the ecological environment or their "satisfaction" with the ecological environment. It is people's positive aspiration to improve the ecological environment. Especially, in arid areas with fragile ecological environments and poor climatic conditions, people hope to improve the natural conditions of their living environment through a series of ecological behaviors. For farmers' decision-making of returning farmland to forests, the initiative of ecological aspiration and the incentive of economic effect are inseparable and should not be ignored. At present, in the research on the decision-making of farmers' G.G.P., most scholars have deeply discussed the subjective of farmers' will of returning farmland to forests. However, the analysis of the results under the expectation is very lacking, that is, the income effect of farmers' multistage decision-making of returning farmland is not analyzed. The performance of the ecological aspiration to implement the sustainable G.G.P. and to promote the increase in farmers' income needs to be answered from the perspective of economics.

Ecological aspiration is a value expectation of farmers' active participation. When farmers' ecological aspiration is high, it is more urgent to actively participate in the G.G.P. When the ecological aspiration is low, the attitude toward returning farmland to forest projects is more passive acceptance or resistance, which will affect farmers' income expectations and future total household income. If farmers are rational "economic people," then starting from the maximization of production profits, combined with the multi-objective function of farmers' production decision-making (Le et al., 2020; Zhang et al., 2020). The decision of farmers' adoption of G.G.P. is a behavior of maximizing economic effects and is driven by ecological aspiration.

Assuming that the behavior of returning farmland to the forest under ecological aspiration has M production goals is the degree of meeting the goal m of farmers, and assuming that each objective function is independent, each objective function is separable and additive. The multi-objective expectation function can be expressed as:

$$MaxE[U(r_1, r_2, \ldots, r_m)] = \sum_{m=1}^{M} w_m f_m(r_m) \quad (1)$$

In the above formula (1), suppose U and $f_m(r_m)$ are between [0, 1] and w_m is also between [0, 1] are the weights of the targets, the sum of which is 1.

The decision-making of returning farmland to forest mainly includes:

- Obtaining the state forestry subsidy.
- Managing the income of economic forest and grass.
- Reducing the input of agricultural labor ($M = 3$).

The absolute value of the weight w_1, w_2, and w_3 reflects the relative importance of the above three main objectives.

The decision-making behavior of G.G.P. includes whether farmers participate and the area of returning farmland after participation. The utility functions of the two different levels are consistent, weighing the relationship between the benefits and losses of returning farmland to the forest. The difference is the change in the relative value of w_{m} in the utility function. In the decision-making stage of whether to return farmland, farmers will pay more attention to the relationship between the income (ΔA) and input cost (ΔC) brought by returning farmland and the national forestry subsidy (ΔS); in the decision-making stage of returning farmland, farmers will comprehensively consider the relationship between the income of non-agricultural workers (ΔL) of the agricultural transferred labor force and the income of economic forest and grass (ΔI). Due to path dependence and risk aversion, fear of job-hunting difficulties, and the uncertainty of economic forest and grass income, farmers may not be willing to accept migrant workers or operate economic forest and grass. At this time, the incentive role of the initial state subsidy is significant.

Therefore, the goal of the decision-making behavior of G.G.P. is the combination of economic goal and ecological goal under the condition of family profit maximization, which should obtain economic benefit and satisfy ecological benefit. Compared with the traditional management mode of non-conversion of farmland, farmers' agricultural production structure, allocation of labor resources, and subsidies for the conversion of farmland have changed, so the decision-making condition of G.G.P. can be expressed as follows:

$$\begin{cases} \Delta A + \Delta C \leq \Delta S \\ \Delta A + \Delta C \leq \Delta L + \Delta I \end{cases} \tag{2}$$

In the above Formula (2), ΔA respects the change in agricultural production income before and after converting farmland to arable land. If farmers participate in the G.G.P., less arable land will be used for farming. The income of farmers will also be reduced, ΔC which refers to the change in input cost before and after returning farmland, including the additional cost incurred by returning farmland (construction supporting funds, purchase of high-quality seedlings, irrigation expenses, etc.), ΔS is a state subsidy, with uniform standards[3], will change with the year; when farmers believe that the reduction in agricultural income and the additional costs of conversion are less than or equal to the number of state subsidies, they will choose to participate in the conversion. The farmers will judge the specific area involved in the conversion of farmland according to the sum of ΔC and ΔA, the relationship between the labor income ΔL released from agriculture and the forest and grass management income ΔI expected from the conversion of farmland. When $\Delta L+\Delta I-(\Delta A+\Delta C) \geq 0$ and the greater the difference, the stronger the farmers' ability of non-agricultural work and management of economic forest and grass, the higher the possibility of participating in the larger area of returning farmland to forest. Therefore, under the goal of maximizing the economic effect, the decision function of G.G.P. is as follows:

$$Maxf(g) = f[\Delta A, \Delta C, \Delta S, \Delta L, \Delta I] \tag{3}$$

From the perspective of farmers' initiatives, farmers should pursue economic and ecological benefits to overcome the difficulties of traditional path dependence and risk aversion. Facing the bad ecological environment in their region, they yearn for the change in their environment, hope that their ecological behavior has a specific value, compare the ecological behavior of their neighbors with a self-perception, and the expectation of their future ecological behavior, the above four aspects are collectively referred to as ecological aspiration (a_i). Under the function of ecological aspiration, the ecological objective and the economic objective are in the same line. When the ecological aspiration of farmers is more robust, the expected ecological value (Δe) of returning farmland to forest is high. The additional cost (ΔC) is less, that is, $\frac{\partial(\Delta e-\Delta C)}{\partial a_i} > 0$. Therefore, considering the goal of ecological value, the function of maximizing the economic impact of the decision-making of G.G.P. can be further expressed as follows:

$$Maxf(g) = f[\Delta A, \Delta S, \Delta L, \Delta I, \Delta e(a_i, C)] \tag{4}$$

Farmers expect future changes in agricultural income, income from forest and grass operations, and additional input costs driven by the traditional intensive farming model. It is based on historical experience judgment, input-output, and risk preference. That is to say, and can be regarded as the expectation of future income of farmers (Δp), the higher the expectation, the more likely to participate in G.G.P. ΔS as a national fixed subsidy, it has an incentive effect in the initial stage of returning farmland to forest. It can be neglected in the later stage of sustainable income promotion. Therefore, the primary motivation for farmers to participate in the G.G.P. is the expectation of future income and the goal of ecological benefits:

$$U{=}w_m f_m(\Delta p(A, L, I, C), \Delta e(a_i, C)) \tag{5}$$

By taking the derivative of (5) for ecological aspiration (a_i), we get:

$$\frac{\partial U}{\partial a_i} = w_m \frac{\partial f_m}{\partial \Delta e}\left(\frac{\partial e}{\partial a_i} + \frac{\partial e}{\partial \Delta p}\frac{\partial \Delta p}{\partial a_i}\right) > 0 \tag{6}$$

Based on the above analysis, farmers' ecological aspirations positively impact the decision to G.G.P. and are driven

3 The overall plan for the new round of returning farmland to forest and grassland takes the bottom-up farmers' voluntary and government guidance as to the operation principle and does not limit the proportion of ecological forest and economic forest. In the 5-year planning plan, ecological compensation is paid three times, namely 800 yuan/mu in the first year, 300 yuan/mu in the third year, and 400 yuan/mu in the fifth year. At the same time, forest grain intercropping and economic development under the forest are encouraged.

by economic implications and ecological benefits. For other farmers, decisions regarding participation in land conversion are motivated by state subsidies, which provide effective and long-term motivations for policy implementation and embody the conversion of farmland to forest based on ecological aspirations; at the same time, the pursuit of economic benefits is maximized. As household income from the G.G.P. increases, the adoption of land conversion is both intensely and fundamentally promoted.

Therefore, the following research hypotheses are proposed:

> H1: Based on the goal of maximizing economic and ecological benefits, ecological aspiration has a positive impact on farmers' participation in returning farmland to the forest.

> H2: Based on the objective of maximizing economic and ecological benefits, income expectations have a positive impact on maintained converted lands instead of returning them to cultivation.

> H3: According to the mechanism by which the economic effect of ecological aspiration promotes returning farmland to forest, ecological aspiration affects the expected income of farmers and then the total income of households.

From a theoretical point of view, when a farmer's ecological aspiration initiative can be engaged, even after the end of the state subsidy, that initiative can continue to be an important factor in increasing farmers' expected income. Farmer initiative and persistence in protecting the ecology through G.G.P. result from the income effect of family labor, cultivated land, and the external environment; however, we still need to generate empirical data by testing the concreteness of factors influencing these relationships. In this article, by applying an economic model to forest and grass in the fragile ecological region of Xinjiang, the effects of returning farmland to forest on ecological protection initiatives and total family income are analyzed using the endogenous transformation model under the counterfactual frame structure. The Tobit model was used to analyze the factors affecting areas of converted land. The mechanism of the ecological aspiration and the income effect was further analyzed by the intermediary effect method. A schematic diagram of this article is shown in **Figure 1**.

Case study and data sources

Case study

Given the timeline of the development process, G.G.P. returning farmland to forests and grassland was first implemented in 1999, and a new round of projects was launched from 2014 to 2020. At present, the new round of the G.G.P. not only highlights farmers' willingness to participate but also incorporates ecological construction and maximizes economic benefits. The existing ecological research shows that human socially productive activities need to balance the carrying capacity between ecology and climate and be aware of motivations for participating in ecological environment construction and coping with climate change.

As a typical arid and ecologically fragile area, the desertification and salinization of land in Xinjiang are severe, and the ecological environment is fragile. Excessive agricultural and social water use have resulted in a sharp increase in the competing pressures on the population, resources, and environmental development in Xinjiang, which has seriously restricted local economic development and social stability (Duan et al., 2021). In December 2015, the Ministry of Finance and seven other departments, including the National Development and Reform Commission, issued a circular on expanding the scale of the new round of conversion of cropland to forests and grassland[4] and noted that "from 2016, the G.G.P. is to incorporate more poverty – alleviation and development tasks." Under this task, Xinjiang adopted the economic forest–grass model. It made intensive use of water resources, which significantly improved the utilization efficiency of water resources and increased the economic benefits for farmers. Water resources are a barrier to agricultural production in Xinjiang, and "fixing land by water" highlights the scarcity of water resources in arid areas. However, many human resources are still needed to irrigate the forest and grassland following grain production for arid Xinjiang to maintain the green program. During the subsidy period, farmers want to access it, who are expected to irrigate the forest and grassland. After the subsidy period, without the incentive of economic compensation, whether farmers will continue to invest in irrigation and to what degree is still a question. In addition, the demand for forest and grassland after G.G.P. is a challenge for the arid area itself. If the G.G.P. and economic output can be combined, will this alleviate several poverty problems, such as water resource constraints, and is this question worthy of further study?

Xinjiang is an arid region of oasis agriculture, and its ecological environment is extremely fragile. Tianshan divides Xinjiang into northern and southern regions according to climate, water source, and landform, as shown in **Figure 2**. North Xinjiang is an important production base for grain, fruits, and vegetables. Southern Xinjiang is a substantial area for cotton, grain, and medical plants. Due to agricultural development, overexploitation of water resources, and severe

4 The state has formulated a new round of compensation policies for returning farmland to forests, with ecological forest compensation for 8 years, economic forest compensation for 5 years, and grassland compensation for 2 years.

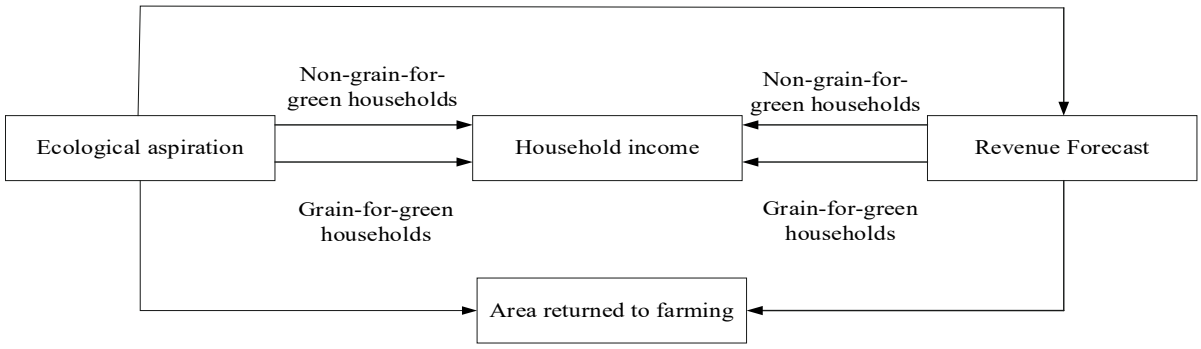

FIGURE 1
Mechanism of ecological aspiration on decision-making and economic effect of G.G.P.

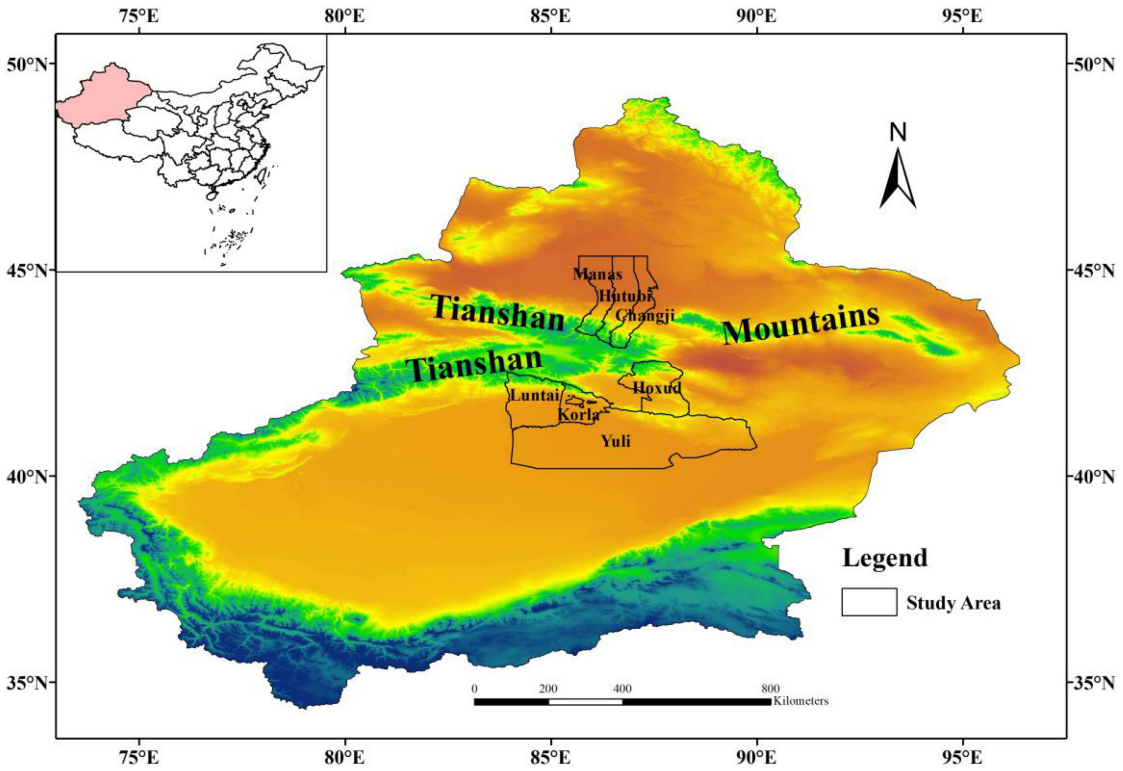

FIGURE 2
Study area and sample distribution.

desertification and salinization of land, Xinjiang has faced tough ecological challenges. Therefore, the G.G.P. must be intensely implemented in Xinjiang, but the arid desert nature of Xinjiang, where more is needed, challenges the project's sustainability. The "economic forest and grass" in Xinjiang has more adaptability to the climate and environment. On the one hand, this model meets the interlaced production characteristics of local agriculture and animal husbandry and adapts to the policy guidance of land degradation and water reduction; on the other hand, due to the late-stage maintenance costs, it is difficult to stimulate farmers' enthusiasm for continuous investment in the single ecological forest.

Data sources

The data of this study are based on the results of a household survey in Changji and Bazhou, Xinjiang, in December 2019. The investigation is mainly based on the basic situation of "the economic forest and grass" pattern in Xinjiang during the

implementation of the new round of G.G.P. We chose Xinjiang Changji and Bazhou farmers as the study objects, with a strong and typical representation.

The survey used "one-to-one" in-house interviews; the sample selection combined stratified and random sampling. Specifically, according to the factors, such as Xinjiang's location, climate, and population, we have identified Changji on the north slope of Tianshan and Bazhou on the south slope as the key investigation areas. Second, in Changji, the team identified Manas County, Hutubi, and Changji city, based on the types of crops planted, the endowment of cultivated land, and the "economic forest and grass" model, in addition to the process of G.G.P. In Bazhou Lunatic County, Yuli County, Hoxud County, and Korla city were selected as sample counties and cities. Three to four townships with a high proportion of households engaged in the G.G.P. were randomly selected in each county and city, three to four sample administrative villages were randomly selected from each township, and six to eight households were randomly selected from each administrative village, to carry out a questionnaire survey. Six hundred fifty questionnaires were distributed, of which 613 were valid, with an efficiency of 94.31%; they comprised 266 in Changji, the north slope of Ten-zan, and 347 on the south slope of Bazhou.

It should be noted that before the household survey, the research team members conducted a presurvey in Bazhou Heshuo County. Based on the findings of the pre-survey, the questionnaire was revised and improved. The survey, designed for household heads or decision-makers with knowledge of household production and management, includes information on ecological aspirations, awareness, willingness, and participation since the implementation of the G.G.P., income structure, quantity, expectation, family labor force endowment, cultivated land resource endowment, cultivated land planting structure, external social environment, and natural environment.

Modeling procedures

Methodology and model setting

Endogenous transformation regression model setting

The endogenous problem is the key aspect of the choice measurement model. This study focuses on the income impact of farmers' choice behavior of G.G.P. Farmers will have an income expectation in the decision-making process of returning farmland to the forest. Therefore, the decision-making process of G.G.P. is not random and has the characteristic of "self-selection," which needs to be corrected in model analysis. Otherwise, it could skew the estimates. Farmers' decision-making behavior of G.G.P. is not only the result of simple external factors, especially the motivation of persistent behavior, but also primarily based on the self-selection decision of ecological aspiration and expected income. This article uses the Endogenous Switching Regression model (E.S.R.) to analyze. There are two reasons for E.S.R. model analysis: first, because the E.S.R. model can effectively distinguish the difference in total household income when farmers are returning farmland to forest or not, it is difficult to determine the cause and effect relationship in a non-random control experiment (Kilgore et al., 2008; Lutter et al., 2019); second, the E.S.R. model can not only identify the factors that affect the total income of households with and without G.G.P. but also identify the factors that affect the total income of households with agricultural land conversion; then, differential analysis can be realized, and the income effect of G.G.P. can be evaluated by using counterfactual analysis method.

Given this, referring to the research of Yeboah et al. (2015) and Mitani and Lindhjem (2021), this article analyzes the income effect of the behavior of G.G.P. in two stages by using the endogenous transformation model. The first stage estimates the decision-making behavior equation of returning farmland to forest, that is, to analyze the influence factors of G.G.P., as follows (7): to compare and analyze the returned farmland farm households and non-returned farmland farm households, respectively, it constructs two-family total income equations, as follows (8):

$$T_i = Z_i\gamma + k_i W_i + \mu_i,\ T_i = \begin{cases} 1\ if T_i^* > 0 \\ 0\ if T_i^* \le 0 \end{cases} \tag{7}$$

$$y_i = \begin{cases} y_{i1} = \beta_{i1} X_{i1}^{'} + \varepsilon_{i1}\ (T_i = 1) \\ y_{i0} = \beta_{i0} X_{i0}^{'} + \varepsilon_{i0}\ (T_i = 0) \end{cases} \tag{8}$$

In the above formulas (7) and (8), Z_i is the influencing factors of farmers' behavior of G.G.P., W_i is the instrumental variable, y_{i1} and y_{i0} are the total household income of farmers participating in and not participating in the conversion of farmland, respectively, $X_{i1}^{'}$ and $X_{i0}^{'}$ are the explanatory variables. When the unobservable factors affect the behavior of G.G.P. and the farmers' total income, there is a correlation between the residual term of the behavior equation and the result equation. Therefore, after estimating the decision equation, calculating the inverse mills ratio $\lambda_i^{'}$, and then introducing it into the resulting equation (8), the following equations (9) and (10) can be obtained:

$$y_{i1} = \beta_{i1} X_{i1}^{'} + \sigma_{\mu 1}\lambda_{i1}^{'} + \varepsilon_{i1},\ T_i = 1 \tag{9}$$

$$y_{i0} = \beta_{i0} X_{i0}^{'} + \sigma_{\mu 0}\lambda_{i0}^{'} + \varepsilon_{i0},\ T_i = 0 \tag{10}$$

In equations (9) and (10) above, $\lambda_{i1}^{'}$ and $\lambda_{i0}^{'}$, respectively, control for the selection bias produced by the unobserved variables, $r_{\mu 1}(r_{\mu 1} = \sigma_{\mu 1}/\sigma_\mu \sigma_{i1})$ and $r_{\mu 0}(r_{\mu 0} = \sigma_{\mu 0}/\sigma_\mu \sigma_{i0})$ with respect to the covariance of the behavior and outcome equations, if the model results test $r_{\mu 1}$ or $r_{\mu 0}$ is significant, the

TABLE 1 Descriptive statistics.

Variable type	Variable name	Mean	Std. dev.	Min	Max
Dependent variable	Whether or not to retire the land for farming	0.339	0.474	0	1
	The area returned to farming	7.648	51.801	0	1200
	Total household income	1.443	6.908	5.737	2.052
Revenue forecast	Change in earnings	0.165	0.372	0	1
	Capability expectation	4.455	1.575	0	7
Ecological aspiration	Regional ecology	0.507	0.500	0	1
	Self-ecology	0.483	0.500	0	1
	Neighborhood ecology	0.600	0.490	0	1
	Aspiration ecology	0.546	0.498	0	1
Family endowment	Sex of head of household	0.786	0.410	0	1
	Age of head of household	51.334	10.104	23	86
	Educational level of the head of household	2.649	0.889	0	10
	Household labor force	2.322	0.999	0	8
The endowment of cultivated land	The salinity of cultivated land	1.886	0.970	1	5
	The fineness of cultivated land	68.221	610.850	0.800	15000
	Degree of water shortage	3.918	1.992	0	7
External environment	Social services	0.302	0.463	0	2
Tool variable	Neighborhood imitation	0.201	0.401	0	1

results show that non-observed variables produce the selection bias. Eliminating the selection bias caused by observed variables and non-observed variables is the precondition to obtaining an unbiased estimation of treatment effect. The estimated results of the endogenous transformation model can be counterfactually analyzed to compare the difference in household income in the real and non-real situations to assess the income effect of G.G.P. By calculation, the average processing effect (ATT) of the processing group and the average processing effect (A.T.U.) of the control group can be expressed as follows (11) and (12):

$$\begin{aligned} ATT_i &= E[y_{i1} \mid T_i = 1] - E[y_{i0} \mid T_i = 1] \\ &= (\beta_{i1}^{'} - \beta_{i0}^{'})X_{i1} + (\sigma_{\mu 1} - \sigma_{\mu 0})\lambda_{i1} \end{aligned} \tag{11}$$

$$\begin{aligned} ATU_i &= E[y_{i1} \mid T_i = 0] - E[y_{i0} \mid T_i = 0] \\ &= (\beta_{i0}^{'} - \beta_{i1}^{'})X_{i0} + (\sigma_{\mu 0} - \sigma_{\mu 1})\lambda_{i0} \end{aligned} \tag{12}$$

Model setting of influence mechanism

This article analyzes the mechanism of ecological aspiration affecting the economic effect of G.G.P., that is, how ecological aspiration can realize the economic effect of returning farmland to forest. According to the analysis of the previous theory, the ecological aspiration embodies the problem of realizing the maximization of economic effect under the goal of ecological value, so the ecological aspiration will directly affect the income expectation of farmers. The income expectation of farmers also affects the total income of households.

To verify the influence mechanism, this article uses the mediating effect analysis methods of Hellerstein (2017) and Johnston et al. (2017). The concrete steps are: first, our study analyzes the direct effect of ecological aspiration on income expectation and judges whether its coefficient is significant; also our study analyzes the mediating role of income expectation between ecological aspiration and family income, that is, the mechanism of ecological aspiration, which promotes the economic effect of G.G.P.:

$$p = \theta_1 + \varphi_1 a_i + \delta_1 \tag{13}$$

$$y = \theta_2 + \varphi_2 a_i + \varphi_3 p + \phi \text{control}_j + \delta_2 \tag{14}$$

In the preceding equations (13) and (14), a_i is the ecological aspirations of farm households, p is the expected income variables, y is the total household income of farm households, control_j is the other control variables that affect the total household income of farm households, θ_1 and θ_2 is the intercept coefficient, φ_1, φ_2, φ_3, and ϕ are the coefficient to be estimated, δ_1 and δ_2 are, respectively, the residual term, $\varphi_1 * \varphi_3$ is the indirect effect of ecological aspiration on total household income, the total effect is $(\varphi_2 + \varphi_1 * \varphi_3)$.

Variable definition and descriptive analysis

Dependent variable

According to Hou et al. (2016) and Acevedo-Charry and Aide (2019), this article divides the decision-making problem into two levels. Among them, the first level is the participation in the G.G.P., that is, whether farmers are returning farmland to forests, which is expressed by two classified variables, the value of participation in the conversion of farmland to forests is 1, and the value of non-participation is 0. The second level is the area of farmers' participation in converting farmland to forests. Since implementing the

TABLE 2 Variable definition and descriptive statistics.

Variable type	Variable name	Definition and assignment	Mean value		Difference
			Partake	Not involved	*T*-value
Dependent variable	Whether or not to retire the land for farming	Are they involved in the conversion of farmland to forests? 1 = Yes; 0 = no	1	0	–
	The area returned to farming	How many M.U. is the area of the land returned to farming?	22.540	0	–
	Total household income	Total household income in 2019 (10,000 yuan, logarithmic)	3.195	1.465	−0.723
Revenue forecast	Change in earnings	Can the conversion of farmland to forests increase the total income of families? 1 = Yes; 0 = no	0.442	0.022	3.993***
	Capability expectation	Can returning farmland to forest promote labor force to go out to obtain more salary or obtain more forest (grass) management income? 1 = strongly disagree, 2 = relatively disagree, 3 = slightly disagree, 4 = generally, 5 = somewhat agree, 6 = relatively agree, 7 = strongly agree	5.466	3.936	4.644***
Ecological aspiration	Regional ecology	Are you satisfied with the climate in your area? 1 = Yes; 0 = no	0.635	0.442	−0.221
	Self-ecology	Do you think you have invested enough in returning land for farming to forestry? 1 = Yes; 0 = No	0.764	0.338	3.085***
	Neighborhood ecology	Does the neighborhood do enough in respect of returning farmland to the forest? 1 = Yes; 0 = no	0.880	0.457	2.565**
	Desired ecology	Do you think the current ecological protection measures are adequate? 1 = Yes; 0 = No	0.774	0.430	−0.705
Family endowment	Sex of head of household	Male head of household = 1; female head of household = 0	0.784	0.788	0.245
	Age of head of household	The actual age of the head of household in 2019	46.300	53.910	−0.224
	Educational level of the head of household	1 = Not attended (illiterate), 2 = Primary School, 3 = Junior High School, 4 = High School, 5 = Junior College and above	3.154	2.390	0.895
	Household labor force	Total number of workers in the family between the ages of 16 and 60	2.697	2.130	0.142
The endowment of cultivated land	The salinity of cultivated land	1 = No salinization, 2 = a small part of cultivated land is slightly salinization, 3 = a part of cultivated land is moderately salinization, 4 = a large part of cultivated land is heavily salinization, 5 = all cultivated land is heavily salinization	1.846	1.906	−2.723***
	The fineness of cultivated land	Area of cultivated land/number of plots of cultivated land (unit: M.U./block)	150.500	25.960	0.573
	Degree of water shortage	The severity of the water shortage? A scale of one to seven indicates increased severity	5.313	3.202	5.324***
External environment	Social services	Does the village provide technical guidance on the conversion of cropland to the forest (including planting technology and marketing of Economic Forest and grass)? 1 = Yes; 0 = No	0.529	0.185	4.263***
Tool variable	Neighborhood imitation	Is the area and energy that Farmer household puts into returning farmland to forestland more? 1 = Yes; 0 = No	1	0	1.994**

*, **, and *** indicate significant levels of 10, 5, and 1%, respectively.

policy of G.G.P., the acreage of farm households from planting to forestry has been measured in Mu. Based on the research of Coomes et al. (2016), this article measures the economic effects of the G.G.P. by using the total family income, including the income from the planting industry, breeding industry, working income, and property income. Descriptive statistics of variables are as shown in Table 1, all variables of the number are 613. In the process of analysis, logarithms were used for regression, as shown in Table 2.

Expected variable of income

The income expectation is the psychological expectation of the family income brought about by implementing the project of G.G.P. For expectations, this article uses two indicators to measure. First, the change in household income sets a dual

virtual variable, "farmers believe that the G.G.P. can promote the increase of household income" to express. Second, the judgment of farmers' income expectation expressed by the Likert seven scale, "farmers' approval degree of returning farmland to forests can promote the labor force to go out to obtain more wages or obtain more income from forest and grass management." 1 means strongly disagree, 7 means strongly agree, and the bigger the number, the more agreed.

Core explanatory variables

The key explanatory variable of this article is the ecological aspiration of farmers in ecologically fragile areas. For measurement of aspiration, this article combines the concept of ecological cognition to measure ecological aspiration from four aspects: regional ecology, self-ecology, neighborhood ecology, and desired ecology. Specifically, in the design of the questionnaire, questions were raised from four aspects, including external environment, self-evaluation, peripheral motivation, and future expectation. The 4 questions are "are you satisfied with the climate and environment in the area you live in?", "do you think you have invested enough in returning farmland to forests?", "do your neighbors do enough in returning farmland to forests?", and "do you think the current ecological protection measures are enough?" To measure farmers' ecological aspirations, the measure variables are 0 and 1.

Control variables

Based on the previous analysis, this article selects 8 variables as control variables from three levels: family endowment, farmland endowment, and external environment.

Family endowment

① Sex of the head of the household. The sex of the head of the home influences the family production decision, especially on the cognition of returning farmland to the forest (Duan et al., 2021). ② Age of the head of a household. The older the family production decision-maker, the more conservative the production model is (Hellerstein, 2017), and the less likely he is to accept the new production model. ③ Education level of heads of household. The more educated the head of the household, the more likely they are to participate in converting cropland to forest and thereby increase their income (Yin et al., 2018). ④ Household labor force. G.G.P. will lead to the redistribution and optimization of household labor resources (Yin et al., 2018), so the number of household labor resources may be a pre-factor in returning farmland to the forest.

The endowment of cultivated land

① Salinity of cultivated land. The salinity of cultivated land is essential in determining boosted land quality. For a long time, under the influence of the oasis and desert agricultural areas in Xinjiang, the salinity of cultivated land has changed dramatically, which has seriously affected the daily production and management of farmers. ② Fineness of cultivated land. Under the common effect of traditional natural factors and external human factors, finely cultivated land has become the decisive factor that restricts the agricultural modernization process. The decision to return farmland to forest is also a path to develop modern agriculture in diversity. ③ Degree of water shortage (Rafael et al., 2018). Under the pressure of groundwater exploitation, the degree of water shortage of cultivated land determines the difficulty of farming. In addition, it has become a factor that cannot be ignored in the decision-making of G.G.P.

External environment

The advancement of social services expresses the external environment of the policy of returning farmland to the forest. Social service is an effective way to promote the new agricultural model, which can overcome the disorder of farmers' production and guide them to participate in the G.G.P. It can provide technical and management help for farmers to convert their farmland into forests and promote their participation.

Tool variables

To improve the accountability of the endogenous transformation model (Hanley et al., 2012), this article selects neighborhood imitation as the instrumental variable. The reason for choosing neighborhood imitation as a tool variable is that neighboring groups usually influence farmers' decision-making behavior. When the neighboring farmers participate more in G.G.P., the farmers may be driven to participate by the neighboring groups. Still, it will not directly affect the area of farmers participating in the conversion of farmland.

The definition and descriptive statistics of each variable and the *T*-test results of the participating and non-participating households are shown in **Table 2**.

Model estimates

Decision-making and income effect analysis of farmers returning farmland to forest

Estimation of results

In this article, STATA15.1 software is used to run the E.S.R. model. The simultaneous estimation results of the decision model and income effect model for returning farmland to the forest are shown in **Table 3**. Log-Likelihood is significant at a 1% level, and the correlation coefficient between the decision model and the total income model is significant at a 1% level. It shows that there are unobservable factors in the sample that affect the decision-making of G.G.P. and the family's total income. In other words, if the model is not modified, the result will be biased (Mitani and Lindhjem, 2021),

TABLE 3 Results of simultaneous estimation of decision-making model and income effect of G.G.P. for farmers.

Variable	Decision model (n = 613)		Income effect model			
			Non-conversion (405)		Conversion (208)	
	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Revenue forecast						
Change in earnings	1.662***	0.313	1.320***	0.400	0.365**	0.144
Capability expectation	0.376***	0.071	0.203***	0.043	0.051	0.057
Ecological aspiration						
Regional ecology	−0.210	0.202	–	–	–	–
Self-ecology	0.615***	0.177	–	–	–	–
Neighborhood ecology	0.946***	0.205	–	–	–	–
Desired ecology	0.114	0.227	–	–	–	–
Family endowment						
Sex of head of household	0.187	0.218	0.112	0.157	−0.010	0.162
Age of head of household	−0.062***	0.012	0.001	0.007	0.003	0.008
Educational level of the head of household	0.436***	0.116	0.175**	0.082	−0.202**	0.080
Household labor force	0.313***	0.103	0.080	0.733	−0.066	0.058
The endowment of cultivated land						
Salinity of cultivated land	0.062	0.085	−0.108*	0.639	−0.222***	0.667
Fineness of cultivated land	0.005***	0.002	−0.001	0.001	0.000	0.000
Degree of water shortage	0.356***	0.049	0.157***	0.038	0.053	0.038
External environment						
Social services	0.676***	0.195	0.415***	0.158	0.430***	0.133
Tool variable						
Neighborhood imitation	1.735***	0.234	–	–	–	–
Constant term	−4.720***	0.774	−0.279	0.520	3.325***	0.604
$\ln r_{\mu 0}$	–	–	0.246***	0.039	–	–
$\sigma_{\mu 0}$	–	–	1.509***	0.377	–	—-
$\ln r_{\mu 1}$	–	–	–	–	−0.105**	0.049
$\sigma_{\mu 1}$	–	–	–	–	0.062	0.172
LR	14.24***		–		–	
Log-likelihood	−1024.425***		–		–	

*, **, and *** indicate significant levels of 10, 5, and 1%, respectively.

so the endogenous transformation model is suitable for analysis. The estimated coefficient is significantly positive at a 1% statistical level, indicating that the total household income of the farmers who have not converted their farmland to forest is higher than that of the average farmers in the sample. The tool variable neighborhood imitation is significant in the decision-making model. Based on the hypothesis of tool variable selection, the tool variable can be regarded as an effective tool.

Analysis of the estimation results

The results of the decision-making model show that both the change in income expectation and the expectation of ability have significant positive effects on the decision-making behavior of G.G.P. The higher the expected increase in household income due to G.G.P., the greater the possibility that the family will participate in returning farmland to forest. The self-ecology, neighborhood ecology, and desired ecology have positive effects on the decision-making behavior of G.G.P., and the self-ecology and neighborhood ecology are significant at a 1% level. The results showed that the more farmers invested in the project, the more likely they were to participate; and the more their neighbors invested in the project, the more likely they were to participate. So, hypothesis 1 is confirmed. From the perspective of the income effect model, the income change has a significant positive effect on the total household income of the households, including have not returned and have returned their farmland to forests. The stronger the positive expectation of farmers for the income changes brought about by the project, the higher the total income of the family, which may be due to the external factors affecting the implementation of the project, for example, the fear of technical incompetence, too much risk,

TABLE 4 Calculation of the treatment effect of the decision-making model of G.G.P. on the total family income.

Farmer group	Decision process		Processing effect	
	Conversion of farmland to forest	Non-conversion of farmland to forest	ATT	ATU
Conversion of farmland to forest	3.196	3.449	−0.253***	–
Non-conversion of farmland to forest	2.872	1.472	–	1.400***

*, **, and *** indicate significant levels of 10, 5, and 1%, respectively.
ATT and A.T.U. showed the average treatment effect of the households returning farmland to the forest and the households not returning farmland to forest, respectively.

which lead to some farmers are willing to retreat but there is no actual behavior.

Among the household endowment variables, the age of the head of household has a significant negative effect on the decision-making behavior of G.G.P. The older the farmers, the more they tend to the traditional farming mode, and their ability to cope with the challenges of resource allocation and risks brought about by returning farmland to forests is weaker. So the possibility of returning farmland to forest is less. The educational level of the head of household has a significant positive effect on the decision-making behavior of G.G.P. and has a significant positive effect on the total family income of the farmers who have not returned farmland to the forest. However, the impact on the total income of households returning farmland to the forest was significantly negative. The results show that the higher the education level of the farmers, the more likely they are to participate in the G.G.P. The number of the family labor force has a significant positive effect on the decision-making behavior of G.G.P. The possible reason is that families with more labor are more willing to realize the transfer of affluent labor. Agricultural production activities are mostly seasonal labor, which requires a lot of labor at a particular time and causes a waste of labor at the rest of the time. The labor force required for forest land operation is relatively small. Families with rich labor can reallocate and optimize labor resources by participating in the G.G.P., realizing the transfer of surplus labor to other industries, and reducing the waste of labor resources (Xue and Yao, 2018; Wu et al., 2020; Wang et al., 2021).

Among the variables of cultivated land endowment, the salinity of cultivated land has a significant negative impact on farmers' total income. The possible reason is that the high salinity of cultivated land will cause dehydration of crop cells, which interferes with the absorption of nutrients by crops. Resulting in the reduction of soil permeability and water permeability, these hazards will seriously affect the yield of farming. As a result, grain production was reduced, the income-generating capacity of cultivated land resources was weakened, and total household income decreased (Wang et al., 2019; Li et al., 2022; Yuan et al., 2022). The fineness of cultivated land has a significant positive impact on the decision-making behavior of returning cultivated land to the forest. Compared with agricultural land, the possible reason is that economic forest and grass land have low requirements for land scale, and most of the cultivated land involved in the G.G.P. are steep slopes and sandy cultivated land that are not suitable for cultivation and have low productivity. Returning this part of cultivated land to forests is the need of China's ecological construction and it is an inevitable choice to change the unreasonable way of land use (Song et al., 2011; Ren et al., 2020). Therefore, the more fragmented the cultivated land, the more hope through the G.G.P. to realize the conversion of food crops to economic forest and grass. The degree of water shortage has a significant positive effect on the decision-making behavior of G.G.P. and has a significant positive effect on the total household income of households that have not returned farmland to the forest. The more likely they are to participate in the process of G.G.P., the more water-scarce the household is. Without participating in the G.G.P., the more severe the water shortage, the higher the total household income is.

The socialized service variables of the external environment have significant positive effects on the decision-making behavior and the total income of the households, indicating that the more the villages where the farmers live provide technical guidance for the G.G.P., the more likely that farmers participate in the conversion of cropland to forest and grassland, and the more the total income of farmers, which shows that social service is an effective external factor to promote the implementation of conversion.

In addition, one of the main concerns of this article is the impact of the decision to return farmland to the forest on household income. The estimated results are shown in **Table 4**. If the farmers have not participated in the program, the total family income will increase by 7.92%, which shows that the participation of the farmers in the program significantly reduces the total family income in the short term. The average treatment effect of the control group (A.T.U.) showed that the total household income would increase by 95.11% if the farmers participated in the program. Participating in the G.G.P. is a long-term investment. Due to large input and no output, the total income of farmers' families decreased at the initial stage of participation. In the short term, the subsidy for G.G.P. will indeed significantly reduce the income inequality of farmers (Li et al., 2013, 2016). Therefore, it is necessary to provide farmers with subsidies for returning farmland in the early stage. Only in

this way can farmers' enthusiasm to participating in the project of returning farmland be protected.

In the long run, the effect of long-term income increase is gradually not significant with the reduction of subsidy standards (Xie et al., 2021). However, as the input of cultivated land decreases and the promotion effect of ecological environment improvement on income increases. The output of fruits and forest products will increase (Pra et al., 2019), and farmers' income will increase. When farmers feel the positive effect of ecological environment improvement on income, their aspiration to improve the ecological environment will increase, and their enthusiasm for active investment in the G.G.P. will increase. Therefore, the implementation of the project in ecologically fragile areas, especially the economic forest and grass model, can promote the realization of ecological and economic goals.

The impact of income expectations on the area of G.G.P. and its robustness test

In the analysis, it is found that there are 405 households without returning farmland. The area of returning farmland is 0, accounting for 66.07% of the total households, which belong to a typical restricted dependent variable (Lutter et al., 2019). To test the robustness of the results, the Tobit model was used to analyze the effects of income expectation, ecological aspiration, and control variables on the area of land conversion. The likelihood ratio (L.R.) was 261.14, which was significant at a 1% level, refusing to explain the original assumption that the coefficient of a variable is zero. The regression results are shown in **Table 5**. Model 1 represents the results of the average marginal effect, and Model 2 represents the results of the bias effect of the returning farmers. The area of the returning farmland is greater than 0. Model 3 shows the bias effect of the actual area returned to farming. The key explanatory variables are consistent with the E.S.R. model, which shows that the above empirical results are relatively robust.

From the results of the three models, it can be seen that both the change in income expectation variable and the ability expectation have a significant positive effect on the area of land conversion, which indicates that based on the goal of maximizing economic effect and ecological benefit, the income expectation has a significant positive effect on the area of farmers returning farmland. H2 has been verified. Specifically, Model 1 shows that the marginal effects of the change in farmers' income on the common area of G.G.P. are 46.95, and the marginal effect of the expected area of capability is 16.18. The results of Model 2 show that the average marginal effect of the change of farmers' income on the actual area returned to farming is 10.67 in the sample, whose actual area returned to farming is greater than 0. The results of Model 3 show that the average marginal effect of the change of income on the actual area returned to farming is 10.38, and the average marginal effect of the change in income on the actual area returned to farming is 3.68. The average marginal effect of capacity expectation on the actual area returned to farming was 3.58. It can be seen that the more farmers believe that G.G.P. can promote an increase in family income, the area of returning farmland to the forest will be larger. The more we think that G.G.P. can encourage the labor force to go out to get more wages or to get more land and forest (grass) income, the larger the area of returning farmland to forest.

How: An analysis of impact mechanisms

To analyze the mechanism of the influence of ecological aspiration on the total family income, this article analyzes the influence of regional ecological variables, self-ecological variables, neighborhood ecological variables, and expectation ecological variables on the total family income through the expectation of income. By analyzing direct and indirect effects, we can understand how ecological aspiration can promote the economic effect of G.G.P. In the analysis process, the macro program process 2.16 provided by Hayes is used. By learning from the practice of Williams and MacKinnon (2018), the Bootstrap method is used to test the influence of variables, 613 sample households are sampled each time, and 5,000 samples are returned from the original samples. The robust standard error and 95% deviation correction confidence interval value of parameter estimation are obtained, and the coefficient's significance test results are analyzed. The test results are shown in **Table 6**[5]. The whole model passed the significance test. The direct impact of various measurement variables on total household income is consistent with the regression results of the E.S.R. model above, which further verifies the robustness of the model.

From the results of **Table 6** of Model (1), it can be seen that the direct influence coefficient of regional ecological aspiration on income expectation is 0.455, which is significant at a 1% statistical level. The direct influence on total family income is positive but not significant. The total effect was 0.2 and significant at the level of 10%. In Model (2), the impact of self-ecological aspiration on income expectation is 0.427, and the direct impact on total household income is 0.420. The impact of income expectation on total household income is 0.189, and the total effect is 0.501, which is significant at

5 Other control variables are controlled in the model. Due to the length, they are not reported in **Table 5**. If necessary, they can be asked by the author.

TABLE 5 Estimation results of Tobit model for the area of conversion of cropland to forest.

Variable	Model 1		Model 2		Model 3	
	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Revenue forecast						
Change in earnings	46.964***	12.428	10.671***	2.852	10.377***	2.755
Capability expectation	16.181***	4.158	3.677***	0.944	3.575***	0.932
Ecological aspiration						
Regional ecology	−17.520	11.251	−3.981	2.558	−3.871	2.488
Self-ecology	36.767***	11.915	8.354***	2.704	8.124***	2.654
Neighborhood ecology	42.107***	13.612	9.568***	3.077	9.304***	3.029
Desired ecology	10.970	12.605	2.493	2.865	2.424	2.787
Family endowment						
Sex of head of household	−30.710**	12.498	−6.978**	2.843	−6.785**	2.791
Age of head of household	−1.320**	0.578	−0.300**	0.131	−0.292**	0.128
Educational level of the head of household	13.243**	5.962	3.009**	1.353	2.926**	1.319
Household labor force	5.010	4.909	1.138	1.115	1.107	1.085
The endowment of cultivated land						
Salinity of cultivated land	−1.066	5.235	−0.242	1.190	−0.236	1.157
Fineness of cultivated land	0.004	0.006	0.001	0.001	0.001	0.001
Degree of water shortage	9.650***	2.754	2.193***	0.626	2.132***	0.613
External environment						
Social Services	29.067***	10.815	6.605***	2.461	6.423***	2.401
Constant term	−211.914***	45.483				
LR	261.140***					

*, **, and *** indicate significant levels of 10, 5, and 1%, respectively.

TABLE 6 Effects of ecological aspirations on total household income.

Model	Variable	Revenue forecast		Total household income		Total effect	
		Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Model (1)	Regional ecology	0.455***	0.118	0.107	0.103	0.200*	0.104
	Revenue forecast			0.204***	0.035		
Model (2)	Self-ecology	0.427***	0.120	0.420***	0.103	0.501***	0.104
	Revenue forecast			0.189***	0.035		
Model (3)	Neighborhood ecology	0.424***	0.123	0.368***	0.106	0.449***	0.107
	Revenue forecast			0.192***	0.035		
Model (4)	Desired ecology	0.695***	0.117	0.132	0.106	0.270**	0.105
	Revenue forecast			0.199***	0.036		

Because the model requires the continuity of intermediary variables, the measure of income expectation is expressed by the expected variable of salary ability on the Likert 7 scale. *, **, and *** indicate significant levels of 10, 5, and 1%, respectively.

the statistical level of 1%, indicating that the more farmers perceive their investment in ecological forest restoration, the greater the impact on total household income through income expectation. In Model (3), the direct effect of neighborhood ecological aspiration on income expectation is 0.424, and the direct effect on total family income is 0.368. The direct effect of income expectation on total family income is 0.192, and the total effect of neighborhood ecological aspiration on household income was 0.449, both significant at a 1% level, which means that the more farmers perceived their neighbors to be doing in returning farmland to forests, the more likely they were to raise their income expectations, in turn, this contributes to the increase in total household income. In Model (4), the effect of expectation ecological aspiration on income expectation is significant at 0.695, the effect on family income is positive but not significant, the effect of income expectation on family income is significant at 0.199, and the total effect of expectation ecological aspiration on household income was 0.270, which was significant at the statistical level of 5%.

According to the mechanism of ecological aspiration promoting the economic effect of G.G.P., ecological aspiration affects the income expectation of farmers and then the total income of families. So, H3 was tested.

Research conclusion

Based on the theory of aspiration and the theoretical model of the economic effects of ecological aspiration on G.G.P., this article intensely analyzes the dual objectives of ecological aspiration leading to ecological benefits and economic effects and the decision-making behavior of farmers returning farmland to forest. Simultaneously, based on the model of economic forest and grass in the ecologically fragile areas of Xinjiang, household survey data were collected, including 613 effective households in southern and northern Xinjiang, using the endogenous transformation regression model to analyze the effect of household income on the behavior of returning farmland to forest and using the Tobit model to analyze the effect of expected income from the area of converted land. Finally, the mechanism of the economic effect of returning farmland to forest was analyzed using the intermediary effect. The main conclusions are as follows: first, in the arid area with fragile ecology, the considerable income from the economic forest and grass pattern is the basis of the lasting motivation for the conversion of farmland to forest. Second, according to the counterfactual hypothesis, the household income of farmers who did not participate in the project would have increased by 7.92%, and that of the farmers who did participate in the project would have been increased by 95.11%. This shows that although farmer participation in the G.G.P. significantly reduces the total household income in the short run, participation increased total household income in the long run. Third, driven by the dual goals of maximizing ecological and economic benefits, income expectations have a significant positive impact on the areas of converted land. Fourth, the mechanism analysis shows that ecological aspirations mainly affect total household income by affecting farmers' expectations. Therefore, implementing the project to return farmland to the forest can promote the realization of both ecological and economic goals.

In arid areas with fragile ecology, the cost of returning farmland to forests is high. When farmers' ecological aspirations are fully mobilized, the economic forest and grass model is implemented. The dual goals of ecological benefits and economic effects are considered. In addition, these actions help to achieve the construction of environmentally friendly areas, carbon peaks, and carbon-neutral goals. This article proposes the following policy recommendations. First, the policy of returning farmland to the forest should be fully integrated with regional climate and soil conditions to find a sustainable driving force for implementing the policy. On the one hand, the ecological aspirations of farmers in arid with ecologically fragile areas will be enhanced, enabling the policy implementers to conform to the national policy of environmental governance for the whole; on the other hand, to improve the ability of non-farm work after the labor force is withdrawn from cultivated land and to guarantee increased total family income after participating in the project, support must be provided for a quality labor force. Second, a strong socialized service system should be implemented to provide technical guidance and water security for farmers returning their farmland to forests in arid with ecologically fragile areas, solve farmers' technical problems, and address rational expectations of low income in the short term; these measures will encourage farmers to increase their participation in G.G.P. Third, a good market system for forest and grass products in arid with ecologically fragile areas should be established, encouraging farmers to participate in new ecological farming models and encouraging the development of a system of socialized services for forest and grass products to provide a better external environment for farmers, stimulate the ecological aspirations of farmers, and improve their ecological farming model to increase income and psychological expectations.

Marginal contribution and future outlook

The marginal contribution of this article is based on the survey data of 613 farmers of economic forest and grass model in arid with ecologically fragile areas of Xinjiang. By using the theory of aspiration and the theoretical model of the economic effects, the ecological aspiration and farmers' income aroused by G.G.P. were discussed. The limitation of this study comes from the availability of survey data. Due to the limitations of energy and funds, as well as the challenges of COVID-19 to field research, this article can only choose Changzhi and Bazhou, which are representatives of Xinjiang, for field research. The universality of the research conclusion needs to be considered. In the future, the research group plans to further research in this field and expand the research field. Further, to explore the economic effect of ecological aspiration on the new round of G.G.P.

Data availability statement

The data analyzed in this study is subject to the following licenses/restrictions: Belong to Study Group Requirements. Requests to access these datasets should be directed to PD, 20180027@sxufe.edu.cn.

Author contributions

PD and SC conceived the research idea, design, and developed the field methods. SC collected the data. PD analyzed the data. PD and XY wrote the manuscript. All authors contributed to review and edit of manuscript drafts.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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