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# Family Identity, Place Identity, and Chinese Farmers' Environment-Friendly Production Behavior

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**Abstract:** In response to the sustainable development goal of agriculture put forward by the United Nations, countries have introduced a series of agricultural environmental protection policies. However, the effectiveness of these policies has been hindered by insufficient responses from farmers. This study begins with the fundamental logic of farmers' production behavior and first introduces family and place identities into the theoretical analysis framework of farmers' environment-friendly production behavior (EPB). Using primary survey data for farmers from the northwestern Chinese province of Gansu, a hierarchical regression and simple slope analysis models were developed to verify how family and place identities affect farmers' EPB. The potential moderating effect of place identity on the relationship between family identity and farmers' EPB is further investigated. The results show that improving family identity has a significantly negative effect on farmers' EPB, while improving place identity can significantly promote farmers' EPB. Compared with respondents who have a low place identity, the inhibitory effect of family identity on farmers' EPB is significantly weakened for those who have a high place identity, which suggests that farmers with a high place identity are more likely to engage in EPBs in agricultural production. This study highlights the importance of considering the economic logic toward maximizing family economic interests and the social logic oriented toward collective interests in the decision-making process of agricultural environmental policies.

**Keywords:** environment-friendly agriculture; farmer's production behavior; family identity; place identity; China



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## 1. Introduction

In order to cope with the increasingly complex climate and environmental changes of the 21st century, the United Nations formulated and introduced the Sustainable Development Goals [1] in 2015. One of these goals involves countries' exploration of sustainable agricultural development [2]. Undeniably, the application of chemical pesticides, fertilizers, and mulch has made an outstanding contribution to improving global crop yield [3]; however, their irrational use has severely polluted the global agricultural environment. According to the Statistical Yearbook of World Food and Agriculture 2022 by the Food and Agriculture Organization of the United Nations, in the past two decades, the global use of pesticides increased by 30% and that of fertilizers increased by 49% [4]. In order to address the pollution problem of farming practices and promote sustainable agricultural development, the traditional production model based on high factor input, high yield, and high pollution urgently needs to change to an environment-friendly production model [5]. Therefore, various environmental protection policies in the agriculture sector have been introduced in various countries. For example, the European Union has developed Agri-Environment Schemes (AES) in 1992 and revised AES in 2007, which aims to incentivize farmers to adopt biodiversity-friendly agri-environmental conditions [6]. Similarly, the Chinese government also proposed in the white paper "China's Green Development in the New Era" to further promote the policies of reducing the amounts of pesticides and

fertilizers and increasing efficiency, as well as the comprehensive utilization of straw [7], and encourage farmers to adopt environment-friendly production behavior (EPB) through subsidies in 2023 [8]. However, the effectiveness of these policies has been hindered by insufficient responses from farmers [9].

For the green development of agriculture, top–down policy planning is essential, but understanding the underlying rationale behind farmers' adoption of EPB and promoting farmers' EPB based on this rationale is a key factor in solving the problem of agricultural pollution [10]. However, existing research on promoting farmers' EPB tends to examine either from the viewpoint of economics or sociology and generally has different solutions, leading to a dilemma for policymakers when formulating agricultural environmental policy.

Previous studies in economic analysis of farmers' EPB generally focus on the comparison of related costs and benefits of best management practices. For example, Chen et al. [11], found that farmers with high recognition of family economic interests are greatly inclined to increase fertilizer input to raise agricultural production. Savari et al. [12], pointed out that adopting EPB may reduce farmers' income. Thus, the more farmers pay attention to family economic interests the more likely they may have a negative attitude toward EPB. Furthermore, Gailhard et al. [13], found that farmers who are more likely to seek or emphasize family economic benefits tend to avoid adopting environment-friendly technologies due to the uncertainty of the production output. Therefore, Gaihard et al. [13], proposed that economic compensation should be given to those farmers to promote the adoption of environment-friendly production technologies to encourage EPB among them.

Recently, scholars have found that while costs rise, farmers may still exhibit EPB [14]. This creates room for discussions from the viewpoint of sociology to investigate the social logic behind farmers' EPB, especially from the perspective of collective interests. For example, previous studies have found that when farmers pay more attention to the collective interests of a village, even if the production cost is greater than income, the farmers may still be willing to adopt EPB [15–17]. Additionally, Schultz [18], from the perspective of altruism, believed that farmers who emphasize collective interests are more likely to be concerned about agricultural environment problems and thereby more likely to adopt EPB in agricultural production. However, some studies also show that collective interests may not influence farmers' EPB [19,20].

From the literature review, we found that existing studies on farmers' EPB from the economics perspective essentially focus on farmers' family identity (i.e., to seek maximum profit from production output) [21]. In contrast, studies from a sociological perspective emphasize their place identity (i.e., to be concerned more about the collective interests of their community) [22]. However, farmers have a double-layered structure of family and village groups. Therefore, farmers may exhibit both family and place identities when undertaking agricultural production. Generally speaking, family is the basic unit of individual behavior decision-making, and family identity primarily guides individual behavior to protect family interests [23]. In agricultural production, the family identity of farmers inevitably leads to the prioritization of family interests [24]. At the same time, farmers' families are deeply embedded in village groups, and place identity based on group interests also affects farmers' agricultural production decisions [25]. This is especially true for China.

In rural China, the traditional governance model in which ancient China's imperial power did not go to the countryside resulted in a village-dominated functional organizational unit dealing with collective affairs. This unit was derived from the rural family structure. Thus, farmers gradually formed a dual identity and action unit that continues today. The action unit is comprised of family identity that focuses on economic interests within the family and place identity that goes beyond family and emphasizes collective interests [26].

As a structural force that extends beyond an individual's family, place identity has spawned survival logic from ancient times in China, where Chinese farmers' families sacrifice private interests to promote public interests [27]. This sacrifice further amplifies the influence of place identity on farmers' family identity on their EPB. Thus, integrating

family identity and place identity into the analysis framework of farmers' EPB is crucial to understanding farmers' behavior. Unfortunately, existing literature mainly explores the EPB of farmers under the single perspective of family identity or place identity, ignoring the potential dual identity structure of family identity and place identity as well as the structural relationship between place identity and family identity. To fill the research gaps above, this study first attempted to construct a theoretical framework of farmers' EPB that incorporates their family identity and place identity to achieve the following research objectives: (1) To investigate how farmers' family and place identities affect their EPB. (2) To examine how place identity, as a structural force beyond the family, shapes the impact of family identity on farmers' EPB. The results of this study could help resolve the inconsistencies and dilemmas in existing economic or sociological studies of farmers' EPB.

## 2. Theoretical Framework

### *2.1. Theoretical Analysis and Hypothesis*

#### 2.1.1. The Impact of Family Identity on Farmers' EPB

Family identity refers to an individual's identification as a family member. It guides their pursuit of maximizing family interests as the goal in both production and daily life [26]. Family interests include both economic and non-economic benefits, such as intergenerational inheritance and sustainable land production, but for China's smallholder farmers, with the current generally low income, family economic interests remain their main focus [28]. Different to the developed market economy of Western countries, Chinese farmers are mainly small-scale farmers and are vulnerable to market risks, resulting in Chinese smallholder farmers paying more attention to the pursuit of short-term family economic interests [29]. As a result, a decision-making system with the family as the basic unit is constructed, guiding the behavior of farmers and shaping their family identity [21].

Against this backdrop, farmers' behaviors, ideas, and standards are all rooted in their families as a focal point of kinship aggregation, and the maintenance of family interests is taken as a source of power. Motivated by family identity, we consider that farmers' agricultural production and related factor inputs all prioritize family economic interests. Given the concern about the high uncertainty of production output and the potential risk of adopting EPB, the pursuit of economic benefits may lead farmers to prioritize currently visible benefits. Under this rationale, farmers with a strong family identity may pay more attention to farm output and avoid adopting any agricultural EPB to seek maximum economic income for their family. Therefore, we propose:

**Hypothesis 1 (H1).** *The higher the levels of family identity, the greater the hindrance to farmers' adoption of EPB.*

#### 2.1.2. The Impact of Place Identity on Farmers' EPB

Place identity refers to the recognition of the external environment, traditional customs, culture, and norms generated by the interaction between individuals and the environment and others within the village area in the process of production and daily life [30]. Based on the development of China's rural society, both the traditional rural society with the governance logic of "the imperial power does not reach to the countryside, which is under the clan in the county" and the modern rural society with the grassroots organization as a representative of state machinery, have created a demand for local functional organizations to handle public affairs in rural China.

For one thing, in traditional rural society, it is difficult for state power to reach villages. State power generally doesn't solve village affairs beyond the scope of family decision-making. Therefore, the necessity of village autonomy has been highlighted. For another, since the founding of New China, farmers have called for the liberation of rural productive forces and the development of the rural economy. Strengthening the creation of rural grassroots organizations has become inevitable under the strategic deployment of socialist modernization. Against this backdrop, place identity has been embedded in

Chinese farmers' logical system of behavioral decision-making for a long time and has been continuously internalized into the code of conduct of farmers. Therefore, the influence of place identity cannot be separated from the behavioral decisions of Chinese farmers. Specifically, a concern about collective interests, sustainable village development, and the natural resources and environment nearby may stimulate farmers' social, cultural, and environmental consciousness to safeguard collective interests and adopt EPB [22,31]. This concern and awareness may reduce short-term egoistic behaviors at the cost of destroying the agricultural environment during agricultural production. As a result, the higher the level of place identity for farmers, the more likely they may manifest EPB. Based on this analysis, we propose:

**Hypothesis 2 (H2).** *Place identity promotes EPB among farmers.*

#### 2.1.3. The Moderating Effect of Place Identity

Although dual identity, comprising family identity and place identity, is a fundamental aspect of guiding farmers' production behaviors, the structural relationship and interaction between place identity and family identity also need to be considered carefully. In the rational logic dominated by family identity, the orientation of farmers' production behaviors coincides with their economic interests, which causes their EPB to be replaced by the economic goal of profit maximization, thereby reducing the possibility of adopting EPB. However, as a structural force above the family unit, the village and community around farmers' families may also affect farmers' family identity on their EPB. Specifically, compared with the farm production goal for maximum output of safeguarding family interests, which is generated by family identity, an elevated place identity may give farmers the spontaneity consciousness to maintain and promote collective interests while stimulating group consciousness of protecting the agricultural environment [32]. Thus, the pursuit of family interests in agricultural production is weakened. As a result, the inhibitory effect of family identity on farmers' EPB is moderated by farmers' place identity. Based on the above analysis, we propose:

**Hypothesis 3 (H3).** *Place identity can mitigate the negative impact of family identity on farmers' EPB.*

### *2.2. Definitions of Variables*

#### 2.2.1. Dependent Variable

A regression analysis was utilized to test the above hypotheses. In this study, our dependent variable is the EPB of farmers. In recent years, the No. 1 Central Document of China has paid attention to crop straw returning, pesticide reduction, and fertilizer reduction as part of the green development of agriculture. Therefore, the elicitation for farmers' EPB mainly focused on these three aspects and was measured using a five-point Likert-type scale. Specifically, these questions in our survey are: "I have returned straw to the field", "I have reduced the use of pesticides per ha in 2022, compared to 2021", and "I have reduced the use of chemical fertilizers per ha in 2022, compared to 2021". Respondents' average score on these three questions was taken as the measurement of farmers' EPB.

#### 2.2.2. Independent Variables

Family Identity (FI). Family identity refers to family members' sense of identity based on family economic interests when making behavioral decisions. In the survey, we referred to the study by Meal et al. [33] and developed the following five questions for collecting respondent's attitudes about family identity: "I agree with the traditional customs and norms of my family", "I share the same values with other members of my family", "I like my family very much", "I take an active part in the collective activities of my family", and "I will be very attached to my family if I move away from my home".

Place identity (PI). Place identity refers to the psychological perception experienced by farmers. It related to their identity with traditional village customs, culture, nature, and norms. Drawing on the studies of Kasarda et al. [34], and Ramkissoon et al. [35], while also considering the realistic environment of small-scale farmers' production in China, we developed the following five questions in our survey for eliciting respondent's attitudes about place identity: "I agree with the cultural customs and norms of my village", "I share the same values with other members of my village", "I like the present village very much", "I actively participate in the collective activities of my village", and "I will be very nostalgic if I move away from my village".

Control variables. Following the existing research on farmers' production behavior [36–38], we selected farmers' demographic and socioeconomic characteristics as control variables in our regression analysis. Demographic characteristics include gender, age, education level, and the number of family members involved in the farming labor force. Socioeconomic characteristics include total annual household income, share of agricultural income, and planting scale.

## 3. Materials and Methods

### *3.1. Hierarchical Regression Model*

Our empirical analysis included examining the impacts of family and place identities on farmers' EPB and that of the interaction between family identity and place identity (as hypothesized in H3) on farmers' EPB. Therefore, by referring to the study by Marsh et al. [39], we adopted a hierarchical regression model for empirical analysis. The essence of the hierarchical regression model is that based on the multiple linear regression model, explanatory variables are divided into various blocks and then added block by block to show differences between different models [40]. In hierarchical regression, control variables are included in the model first, followed by the core explanatory variable. This approach allows us to thoroughly investigate the contribution of the core explanatory variable to the regression results independent of the influence of other variables. If the core explanatory variable has a significant contribution, we can conclude that its effect cannot be replaced by other variables [41]. The formulas are as follows:

$$EPB = \alpha_0 + \sum_{i=1}^{n} \alpha_i X_i + \varepsilon \quad (1)$$

Equation (1) only contains $EPB$, control variable $X_i$, and residual $\varepsilon$. Building upon this equation, we incorporate family identity and place identity to obtain Equation (2):

$$EPB = \alpha_0 + \sum_{i=1}^{n} \alpha_i X_i + \beta_{FI} FI + \beta_{VI} PI + \varepsilon \quad (2)$$

In Equation (2), $FI$ represents family identity and $PI$ represents place identity. On this basis, the interaction between the two identities is added to obtain Equation (3):

$$EPB = \alpha_0 + \sum_{i=1}^{n} \alpha_i X_i + \beta_{FI} FI + \beta_{VI} PI + \gamma FI \times PI + \varepsilon \quad (3)$$

where $FI \times PI$ represents the interaction between family identity and place identity. $\alpha_I$, $\beta_{FI}$, $\beta_{PI}$, $\gamma$, and $\varepsilon$ are the parameters to be estimated.

### *3.2. Simple Slope Analysis*

Based on the research by Preacher [42], this paper further used simple slope analysis to investigate how place identity moderates the influence of family identity on farmers' EPB. Place identity is categorized into two groups based on one standard deviation above and below the mean. The group with one standard deviation below the mean is regarded as a low-place identity group, and the group with one standard deviation above the mean

is viewed as a high-place identity group. Subsequently, linear regression models with interactive terms were applied to the two groups. This analysis aimed to assess whether the influence of family identity on farmers' EPB varies under different groups of place identity.

We grouped place identity based on one standard deviation above and below the mean:

$$\text{Low Place Identity: } M_{PI} - SD_{PI}$$

$$\text{High Place Identity: } M_{PI} + SD_{PI}$$

where $M_{PI}$ refers to the mean of place identity and $SD_{PI}$ refers to the standard deviation of place identity.

Then, the control variables were added to the two groups, and linear regression was performed simultaneously:

$$EPB = \alpha_0 + \sum_{i=1}^{n} \alpha_i X_i + (\beta_{FI} + \gamma PI)FI + \beta_{PI} PI + \varepsilon \quad (4)$$

($\beta_{FI} + \gamma PI$) is the slope, which reflects how the influence of family identity on farmers' *EPB* is regulated by place identity. By examining whether the regression coefficient of family identity on farmers' EPB changes in different groups, we can judge whether place identity can affect family identity on farmers' EPB in different groups of place identity.

### *3.3. Study Area and Data Collection*

We chose Gansu Province as a study area mainly because its economic development is relatively backward. In 2022, Gansu Province's per capita GDP was only 45,000 yuan, the lowest among China's 31 provinces, municipalities, and autonomous regions. Due to lagging economic development, local governments generally emphasize economic development while neglecting environmental protection in the agriculture sector, leading to severe environmental pollution. From the perspective of sampled provinces, Gansu Province is in the northwest of China and covers an area of 425,800 $km^2$, 12% of which is agricultural land. The main crops cultivated are corn, wheat, potato, vegetables, Chinese herbal medicine, and oilseeds, with corn having the largest planted area, accounting for 26.3% of the total agricultural land in 2021. Therefore, we selected corn farmers as our survey subjects.

Before conducting the formal survey, we randomly selected 30 corn farmers in Maying Village, Yuzhong County, Lanzhou City for a preliminary survey in early March 2023. The questionnaire was further revised according to the preliminary survey results and comments from the respondents to ensure the reliability and validity of the questionnaire prior to use. The questionnaire includes three parts: (1) the first part of the questionnaire collected information of respondents' demographic and socioeconomic characteristics; (2) the second part of the survey was intended to elicit information on farmers' EPB; and (3) the third part of the survey was questions related to respondents' attitudes about family and place identities.

A primary survey for corn farmers in five cities of the Gansu Province was conducted from March to April 2023. The survey was administered in the form of face-to-face interviews by trained interviewers. During the face-to-face interview, the interviewers first explained the purpose of the survey and provided related information on EPB, place and family identities and then collected data when the respondents had fully understood. This approach was undertaken to avoid response bias caused by a misunderstanding.

Stratified random sampling was adopted for the formal survey. Considering the differences in economic development between regions, we randomly selected five cities first (including Lanzhou, Dingxi, Tianshui, Pingliang, and Baiyin). We then randomly selected two to three counties (districts) in each city, two to three townships (towns) in each county (districts), and finally, two to three villages in each township (towns). In each village, we randomly distributed 10–15 questionnaires based on the actual number of farmers. A total of 510 questionnaires were distributed in this survey. After removing invalid questionnaires,

such as those containing incomplete information, 503 valid questionnaires were collected, resulting in an effective response rate of 98.6%.

## 4. Results and Discussion

### *4.1. Descriptive Statistics*

Table 1 presents the demographic and socioeconomic characteristics of the respondents in our survey. According to the survey, 59.0% of the respondents were male, with an average age of 55.7 years, which is consistent with the current situation, referred to as "agriculture for the elderly" in China. Only 9.2% of respondents have a high school degree or above. In comparison, 81.8% of the respondents are illiterate or have only a primary education level, indicating that the overall education level of farmers is not high. In addition, 90.5% of respondents are households who have no more than three members in the labor force. These figures are related to the migration of young Chinese farmers to cities in recent years. There is a considerably large percentage (86.3%) of respondents whose annual household income is less than CNY 50,000 (equivalent to USD 7235). Additionally, more than half of respondents (51.1%) have agricultural income that accounts for at least half of their total annual income, indicating that agricultural income is still the primary source of income. In 42.5% of respondents, the area planted is less than 0.5 ha, consistent with China's smallholder farmers' production and management characteristics. Therefore, our sample data is representative to a certain extent.

**Table 1.** Socioeconomic and demographic characteristics of survey samples.

| Control Variable | Definition | Classification | Percentage (%) | Mean | SD |
|---|---|---|---|---|---|
| Gender | Gender | Male: 1<br>Female: 0 | 59.0<br>41.0 | 0.6 | 0.5 |
| Age | Age | <45<br>45–60<br>>60 | 14.3<br>58.7<br>27.0 | 55.7 | 12.2 |
| Edu | Education level | Never been to school: 1<br>Elementary school: 2<br>Junior high school: 3<br>High school or technical secondary school or vocational high school: 4<br>Junior college or vocational college and above: 5 | 25.0<br>32.4<br>33.4<br>6.6<br>2.6 | 2.3 | 1.0 |
| Labor | Total household labor force | 0–1<br>2–3<br>>3 | 18.7<br>71.8<br>9.5 | 2.1 | 1.0 |
| Income | The annual income of households (ten thousand CNY) | 0–5 (equivalent USD 0–7235)<br>>5 | 86.3<br>13.7 | 2.7 | 3.7 |
| Prop | Proportion of annual agricultural income | Less than 50%<br>More than 50% | 48.9<br>51.1 | 0.6 | 0.4 |
| Scale | Planting scale (ha) | <0.5<br>0.5–2<br>>2 | 42.5<br>50.1<br>7.4 | 0.8 | 0.6 |

SD is standard deviation.

Table 2 presents descriptive statistical results of farmers' EPB from our survey samples. The results show that the average values of the three indicators (questions) measuring farmers' EPB are all below three, indicating that the respondents have relatively low adoption rates of EPB practices in agricultural production. Since agri-environmental pollution is relatively severe in the surveyed areas, changing farmers' traditional farming behavior and promoting the green development of agriculture has become an urgent issue.

**Table 2.** Survey respondents' results regarding environment-friendly production behavior (EPB) on farmlands.

| Environment-Friendly Production Behavior (EPB) | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | Mean | SD |
|---|---|---|---|---|---|---|---|
| I have returned straw to the field | 21.1% | 33.2% | 23.3% | 13.3% | 9.1% | 2.6 | 1.2 |
| I have reduced the use of pesticides per ha in 2022, compared to 2021 | 13.9% | 35.6% | 20.3% | 20.3% | 9.9% | 2.8 | 1.2 |
| I have reduced the use of chemical fertilizers per ha in 2022, compared to 2021 | 13.5% | 33.6% | 20.1% | 21.1% | 11.7% | 2.8 | 1.2 |
| Composite of farmers' environment-friendly production behavior | - | - | - | - | - | 2.7 | 1.0 |

EPB was measured using a 'Likert scale (1 = "strongly disagree", 2 = "disagree", 3 = "neutral", 4 = "agree", 5 = "strongly agree"). SD is standard deviation. Composite of farmers' environment-friendly production behavior is a composed variable, which was measured by the average score of the three questions in Table 2.

The measurement results of family identity and place identity are shown in Table 3. The average scores of the five indicators of the respondent's family identity are all approximately four, which indicates that the respondent's family identity is generally high. To a certain extent, economic income is still the main concern for farmers in areas with relatively backward economic development. One the other hand, the average scores of the five indicators (questions) related to the respondent's place identity are all around three, indicating that compared with the results of the respondent's family identity, the respondent's place identity is relatively low.

**Table 3.** Survey of respondent's reviews on family and place identities.

| | Independent Variables | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | Mean | SD |
|---|---|---|---|---|---|---|---|---|
| FI | I agree with the traditional customs and norms of my family | 10.0% | 5.4% | 11.5% | 43.3% | 29.8% | 3.8 | 1.2 |
| | I share the same values with other members of my family | 10.1% | 13.7% | 16.5% | 34.2% | 25.5% | 3.5 | 1.3 |
| | I like my family very much | 0.0% | 0.6% | 5.6% | 42.9% | 50.9% | 4.4 | 0.6 |
| | I take an active part in the collective activities of my family | 1.2% | 6.2% | 17.7% | 42.7% | 32.2% | 4.0 | 0.9 |
| | I will be very attached to the family if I move away from my home | 0.2% | 0.4% | 5.2% | 45.9% | 48.3% | 4.4 | 0.6 |
| | Composite of family identities | – | – | – | – | – | 4.0 | 0.7 |
| PI | I agree with the cultural customs and norms of my village | 24.5% | 13.3% | 28.6% | 15.1% | 18.5% | 2.9 | 1.4 |
| | I share the same values with other members of my village | 17.3% | 26.8% | 23.9% | 19.5% | 12.5% | 2.8 | 1.3 |
| | I like the present village very much | 2.4% | 6.2% | 42.9% | 24.8% | 23.7% | 3.6 | 1.0 |
| | I actively participate in the collective activities of my village | 22.1% | 20.5% | 24.8% | 16.1% | 16.5% | 2.8 | 1.4 |
| | I will be very nostalgic if I move away from my village | 3.2% | 6.1% | 39.2% | 22.1% | 29.4% | 3.7 | 1.1 |
| | Composite of place identities | - | - | - | - | - | 3.2 | 1.0 |

Both family identity (FI) and place identity (PI) were measured using the five-point Likert scale (1 = "strongly disagree", 2 = "disagree", 3 = "neutral", 4 = "agree", and 5 = "strongly agree"). The mean values of the two groups of indicators were added up, and they represent place identity and family identity. The reliability test results showed that Cronbach's $\alpha$ values of family and place identity were 0.76 and 0.83, respectively, indicating that the adopted measurement items were reliable. SD is standard deviation. The composite of family identities and composite of place identities are composed variables, which were measured by the average scores of the five questions of FI and PI, respectively.

### *4.2. Family Identity, Place Identity, and Farmers' EPB*

We used a hierarchical regression model to analyze the effects of family identity and place identity on farmers' EPB while exploring the moderating effects of place identity on the relationship between family identity and farmers' EPB. For the potential multicollinearity issue, we utilized Groemping's method and centralized respondents' family and place identities [43]. The results are shown in Table 4.

**Table 4.** Hierarchical regression results of the effects of family identity and place identity on respondent's EPB.

| Variables | Model 1 | | Model 2 | | Model 3 | |
|---|---|---|---|---|---|---|
| | Coef. | SD | Coef. | SD | Coef. | SD |
| Constant | 2.739 | 0.304 | 2.993 | 0.113 | 3.041 | 0.115 |
| Gender | 0.001 | 0.092 | −0.006 | 0.034 | −0.002 | 0.034 |
| Age | −0.013 *** | 0.004 | −0.005 *** | 0.001 | −0.005 *** | 0.001 |
| Edu | 0.303 *** | 0.048 | 0.031 * | 0.019 | 0.028 | 0.019 |
| Labor | −0.025 | 0.045 | −0.028 * | 0.017 | −0.027 | 0.017 |
| Income | 0.013 | 0.013 | 0.010 ** | 0.005 | 0.009 * | 0.005 |
| Prop | 0.111 | 0.126 | 0.037 | 0.047 | 0.033 | 0.047 |
| Scale | −0.018 | 0.072 | −0.052 * | 0.027 | −0.052 * | 0.027 |
| FI | - | - | −0.394 *** | 0.044 | −0.417 *** | 0.045 |
| PI | - | – | 0.745 *** | 0.033 | 0.746 *** | 0.032 |
| FI × PI | - | - | - | - | 0.054 ** | 0.024 |
| Obs | 503 | | 503 | | 503 | |
| $R^2$ | 0.143 | | 0.882 | | 0.883 | |
| $\Delta R^2$ | – | | 0.738 *** | | 0.001 ** | |
| F | 11.84 | | 408.48 | | 371.27 | |

Coef. refers to the regression coefficient of each variable on the dependent variable, SD refers to the standard deviation, Obs refers to the total sample size, $R^2$ refers to the goodness of fit, $\Delta R^2$ refers to the changes in goodness of fit, and F refers to the F statistic value. *, **, and *** represent the significance levels of 10%, 5%, and 1%, respectively.

According to the results shown in Table 4, the following observations can be made: Model 1 only contains respondents' demographic and socioeconomic characteristics, and the model's goodness of fit is 0.143. The two core variables of family and place identities were introduced into Model 2 based on Model 1. Upon this introduction, the goodness of fit increased to 0.882, and the change was significant at the 1% significance level, indicating that the model's explanatory power was significantly enhanced after incorporating family and place identities. In order to study the moderating effect of place identity on the relationship between family identity and farmers' EPB, we introduced the interaction term of place identity and family identity in Model 3 based on Model 2. The goodness of fit of Model 3 was 0.883, representing a significant and additional increase of 0.001 compared to Model 2. This result indicates that the moderating effect of place identity exists.

According to the regression results, both family and place identities are key factors affecting respondents' EPB. Family identity has a significant negative impact on respondents' EPB, indicating that the higher the family identity, the lower the possibility for farmers adopting EPB, thereby verifying hypothesis 1. This finding is consistent with the research results of Sutherland [44], who studied the market returns of farmers in England and found that the more farmers pay attention to family economic interests, the more emphasis they place on profitability in agricultural production, which results in a reduced likelihood of adopting EPB practices. Chen et al. [45], investigated the crop straw recycling behavior of Chinese farmers and found that returning straw to the field increases their production cost compared with direct burning. The increase in production cost will reduce the interest of families in production, and therefore leads to a decrease in the likelihood of adopting EPBs.

Results of our analysis also corroborated the finding of Bartkowski et al. [46], who argued that economic factors play one of the most critical roles in influencing the behavioral decisions of farmers. In this context, the higher the family identity of farmers, the more they

will pay attention to economic benefits in agricultural production, thus making them ignore EPB. Currently, the price of environment-friendly fertilizers and pesticides is generally higher than that of traditional (chemical) fertilizers and pesticides [47,48]. Therefore, choosing environment-friendly fertilizers and pesticides will increase the agricultural production cost of farmers, and the economic benefits to families will be weakened to some extent. Moreover, farmers' EPBs could generate positive externalities to the rural environment [49]. Thus, adopting EPB leads to an increase in farmers' private production costs and may contradict their family interests for profit maximization. This finding is consistent with the theory of production economics, where the production behavior of farmers is driven by a financial cost–benefit analysis. Consequently, under the assumption of a rational economic agent, farmers with a higher family identity will avoid any production behaviors that may be against their family interests, thereby restraining the adoption of EPB. This finding also supports the rationality of the current agricultural policy of promoting farmers' EPB by utilizing ecological compensation from an economic perspective.

Our research results differ from those of Domenico and Miller [50], who investigated farmers' production behaviors on British family farms. Their study revealed that even when farmers pay attention to family economic interests in farm production, farmers still adopt EPB. A possible reason is that in Domenico's study, farmers' income comes from farming and largely depends on family farm tourism. While farmers aim at improving family income in agricultural production, they also emphasize providing a favorable ecological environment and paying great attention to tourists' farm experiences to enhance overall returns. Thus, we believe that Domenico and Miller's research has not essentially deviated from the cost–benefit analysis paradigm of farmer's behavior.

Results that place identity has a significant positive impact on farmers' EPB (i.e., the higher the farmers' place identity, the more likely they are to implement EPB practices) verify our hypothesis 2 and align with the findings of Meng et al. [51], who studied the EPBs of farmers in Jinan, China and discovered that farmers who have stronger identity with their village are more likely to carry out environment-friendly production. The study by Valizadeh et al. [22], also revealed that when place identity is high, farmers will pay great attention to collective interests and put these interests above individual interests, which increases the likelihood of adopting EPB in agricultural production. From the perspective of ontology of place, the key to promoting EPB of farmers lies in understanding the interaction between nature and farmers' agricultural production [52]. When the local identity is higher, the closer the emotional connection between farmers and the local community, the stronger their environmental awareness, and the more likely they are to have EPB. The study of Abadi et al. [53], had similar findings. They studied the water pollution control behavior of rural residents from the perspective of local ontology and believed that the identification of local environmental ontology attributes is conducive to enhancing rural residents' awareness of the crisis of environmental pollution, so as to make their attitude towards environmental protection more positive. In fact, from the perspective of local ontology, local identity strengthens the dependence of farmers on the local area, making the maintenance of collective interests a cultural consciousness and cultural instinct of farmers [54]. Therefore, by highlighting the social identity of farmers, it can promote the transformation of farmers' behavior from paying attention to family interests to collective interests [22], thereby improving the possibility of farmers' EPB, and changing their behavior logic that is only characterized by profit-seeking. The policy implication of this important result is that the formulation of environmental protection policies in agriculture should consider not only the economic characteristics of farmers' production but also the social characteristics that are constrained by village groups.

Our results of the interaction between place identity and family identity having a significant positive effect on farmers' EPB, suggest that improving place identity could mitigate the negative impact of family identity on EPB; therefore, hypothesis 3 has been verified. Since farmers' family identity is mainly based on the household's economic interests, which may cause farmers to be less willing to apply any environment-friendly

farming practices on their farmlands if the practices may damage their economic interests. However, the introduction of place identity effectively moderates the negative impact of family identity on farmers' EPB.

Regarding the effects of control variables on farmers' EPB, our results show that several factors could significantly affect farmers' EPB. These factors include the respondent's age, education level, the size of the family labor force, annual household income, and planting scale. Age had a significant negative impact on farmers' EPB, which is consistent with the findings of Abdollahzadeh et al. [55]. As farmers age, the awareness and acceptance of new environment-friendly pesticides, fertilizers, and straw management decrease, the traditional extensive production and managerial practices also become difficult to change, and thereby older farmers are reluctant to adopt new green production models.

Respondents' education level has a significant positive effect on farmers' EPB. A high education level is conducive to improving farmers' possibility of adopting EPB. This finding aligns with the research conducted by Jallow et al. [56], who found that higher education farmers clearly understand the harm of agricultural pollution on the environment and are strongly motivated to adopt EPB.

The size of the family labor force significantly negatively impacts farmers' EPB. One possible reason is that the scale of cultivated land is limited under the current small-scale farming in China. Increasing the labor input on farmlands may reduce the marginal income of the labor force and therefore increases farmer's family survival pressure to some extent. This may force farmers to pay more attention to economic benefits in agricultural production and neglect environmental protection of farmlands.

Total annual household income significantly influences the EPB of farmers. Generally, farmers with higher household income are more likely to afford the increased costs related to environment-friendly production activities [57]. Therefore, it is suggested that the government should use various channels to expand farmers' income.

The planting scale has a significant negative impact on farmers' EPB. A possible reason is that the planting scale is closely related to farmer's agricultural income. As the scale of farming operations increases, farmers face higher risks associated with adopting EPB practices, resulting in a decline in the likelihood of engaging in such practices.

Notably, we found that respondents' gender did not significantly affect farmers' EPB, which is inconsistent with the findings of Casalo et al. [58], and Escario et al. [59], who reported that EPBs were significantly higher in females than in males. A possible reason is that these two studies mainly focused on farmers in developed countries such as Spain, and the respondent's average age is relatively young (i.e., 49.9 years old). However, the phenomenon of "elderly agriculture" in rural China is quite severe. Under "elderly agriculture", farmers' production behaviors are mainly based on their past traditional experience, and there are no behavioral differences due to gender.

### *4.3. Further Analysis of the Moderating Effect of Place Identity*

In order to further analyze the moderating effect of family identity on farmers' EPB, we conducted a simple slope analysis of the interaction terms of family identity and place identity. The control variables were the same as in the previous analysis. Place identity was classified based on the mean value. One standard deviation below the mean value was considered a lower place identity, while one standard deviation above the mean was considered a higher place identity. We assessed the influence of family identity on farmers' EPB under these two situations.

As can be seen from Table 5, for respondents who have low place identity, their family identity tends to have a high negative impact on farmers' EPB, and they are inclined to pursue economic benefits in agricultural production, resulting in a relatively low likelihood of engaging in EPB. However, for those with high place identity, the inhibitory effect of farmers' family identity on EPB is significantly weakened, which makes those respondents more likely to engage in environment-friendly practices during farm production.

**Table 5.** Simple slope analysis results of the moderating effect of family identify on farmers' EPB under different place identity groups.

| Dependent Variable | Place Identity Grouping | Coef. | SD |
|---|---|---|---|
| EPB | Low Place Identity | −0.469 *** | 0.055 |
| | High Place Identity | −0.365 *** | 0.046 |

Coef. refers to the regression coefficient of family identity on farmers' EPB, and SD refers to the standard deviation. *** represents significance at the 1% level.

The results shown in Table 5 further support our main research findings that as place identity improves, the dominant focus on family economic interests at the expense of the village environment becomes suppressed, while the collective consciousness, focused on the overall interests of the village, becomes prominent. Farmers tend to prioritize the protection of the agricultural environment in their production activities. Driven by factors such as the village environment and culture, farmers' demands for economic interests influenced by family identity are weakened. As a result, farmers may give up some of their farm production profits, thus fostering EPB [60]. It is important to note that, for thousands of years, the characteristics of ethical standards and differential patterns in the Chinese countryside have shaped a highly interconnected social fabric combining blood relations and geographic ties. The economic interest barriers based on farmers' family identity are undermined by the collective interests arising from farmers' need for village organization and participation in public affairs under the influence of place identity.

## 5. Conclusions and Policy Implications

Environmental protection in the agriculture sector is an essential part of the sustainable development of agriculture. Correctly guiding farmers' EPB is the key to promoting agricultural sustainability. Based on agricultural household survey data from 503 respondents in Gansu Province, China, this study investigated the effects of family and place identities on farmers' EPB and the moderating role of place identity on the relationship between family identity and farmers' EPB. We made some interesting and important findings.

Firstly, family identity significantly inhibits farmers' EPB, which means that the policy initiatives represented by agricultural ecological compensation can incentivize farmers to adopt EPB. Therefore, the government can subsidize those who adopt environment-friendly production behaviors, internalize the externalities of environment-friendly products, and make up for the loss of economic benefits caused by implementing EPB behaviors under the influence of family identity.

Secondly, our results show that place identity significantly promotes farmers' EPB, which suggests that policies and measures to enhance place identity can promote farmers' EPB. For example, policy interventions that strengthen the emotional connection between farmers and the local area can positively impact farmers' EPB [15,22].

Furthermore, the results of our analysis also show that place identity can moderate the negative impact of family identity on farmers' EPB. This result may imply that the decision-making process of agricultural environment policies should consider not only the economic logic based on family economic interests but also the social logic influenced by the collective interests of farmers. Explicitly, strategies that focus on expanding farmers' income through multiple channels, fully exploiting and utilizing the unique norms, customs, and culture of a village, deepening the emotional connection between farmers and the village, and balancing the conflict between family interests and collective interests, are all effective ways to promote farmers' EPB.

There are several limitations in our study that should be mentioned. First, due to the limitation of cross-sectional data, we might include some farmers who occasionally reduced their pesticide and fertilizer application in 2022 compared with 2021 rather than by intention to adopt EPB. Moreover, due to budget and time constraints, we did not consider the differences in rural social structure in different study areas. Furthermore, we did not carry out a regional heterogeneity analysis, which could be improved upon by further

research. Despite these limitations, we believe that our results have provided insights for policymakers and agricultural managers to formulate effective policies of environmental protection in agriculture with consideration of farmers' duality between family identity and place identity. The theoretical framework we developed and the empirical analysis we verified could facilitate the discussion and contribute to the knowledge of farmer's environmental production behaviors.

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