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Determinants of Agricultural Labor Participation of Rural Elderly People: Empirical Evidence from China

Feifan Yang [1] ***, Ligao Bao*** [2] ***, Dan Li*** [3] ***, Atsushi Chitose*** [4]***, Jiajun Wang*** [5]***, Haisong Nie*** [6*]

[1] *Joint Doctoral Program for Sustainability Research, Graduate School of Engineering, Tokyo University of Agriculture and Technology, Kogane City, Tokyo 184-8588, Japan*

[2] *Department of Socio-Economics, Faculty of Economics, Daito Bunka University, Higashimatsuyama-Shi, Saitama 355-8501, Japan*

[3] *Graduate School of Global Environmental Studies, Kyoto University, Sakyo-Ku, Kyoto 606-8501, Japan*

[4] *Faculty of Agriculture, Tokyo University of Agriculture and Technology, Fuchu City, Tokyo 183-8509, Japan*

[5] *Law School, Shanghai University of International Business and Economics, Songjiang District, Shanghai 201620, China*

[6] *Division of International Environmental and Agricultural Science, Institute of Agriculture, Tokyo University of Agriculture and Technology, Fuchu City, Tokyo 183-8509, Japan*

ABSTRACT

Against the backdrop of a rapidly aging population and a shrinking agricultural labor force globally, this study investigates the driving mechanisms underlying sustained agricultural labor participation among rural elderly individuals in China. Utilizing three-wave longitudinal data (2016, 2018, and 2020) from the China Longitudinal Aging Social Survey within the theoretical frameworks of active aging and productive aging, this research employs Logit regression models to systematically examine how individual characteristics, family structure, health status, subjective eldercare perceptions, and social security coverage are associated with agricultural work engagement. Robustness checks and heterogeneity analyses confirm stable, significant associations: male gender, agricultural

*CORRESPONDING AUTHOR:
Haisong Nie, Division of International Environmental and Agricultural Science, Institute of Agriculture, Tokyo University of Agriculture and Technology, Fuchu City, Tokyo 183-8509, Japan; Email: nie-hs@cc.tuat.ac.jp

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Hukou, higher cognitive ability, larger offspring numbers, better self-rated health, pain experience, preference for self-home eldercare, and receipt of an old-age allowance or basic pension are all positively associated with the likelihood of agricultural participation. Younger elderly individuals show significantly higher engagement in agricultural labor than their older counterparts. Critically, health status emerges as essential human capital, enabling prolonged labor despite socioeconomic pressures, while "elderly agriculture" functions as an indispensable self-support strategy, mitigating eldercare crises through extended independent farming capacity supported by land rights and mechanization. Policy implications urge prioritized enhancements to rural healthcare systems, the optimization of pension benefit structures to strike a balance between sustainability and labor supply, the securement of land management rights to maintain autonomous livelihood arrangements, and targeted social security reforms that acknowledge rural-urban income disparities. This study provides empirical evidence for addressing sustainable agricultural development amid demographic transition.

Keywords: China Longitudinal Aging Social Survey; Elderly Farmer; Rural Aging; Self-Support; Social Security; Active Aging; Productive Aging

1. Introduction

Global demographic trends highlight the inversion of the age pyramid, with populations aged 65 and older constituting the fastest-growing segment within agricultural communities [1]. The "aging" of the agricultural labor force is a pressing issue faced worldwide. For instance, Australia shows a growing proportion of farmers over 65 [2,3], while nearly one-third of European farmers are over 65 [4], raising concerns about agricultural sustainability and the rural future [5,6]. Ireland mirrors this trend, with 30% of farm holders aged 65 and over in 2016 [7]. Similarly, in the United States, the 2017 Agricultural Census found that 34% of farmers were aged 65 and over [8]. Japan, with one of the world's most aging societies, has over 53% of its small agricultural workforce aged 65 and over [9,10]. Population aging has had a significant negative impact on Japan's agricultural development, affecting not only agricultural progress and food security but also threatening the very existence of rural communities themselves [11]. China, with the world's largest elderly population, faces parallel challenges. As industrialization and urbanization draw young and middle-aged laborers to non-agricultural sectors, the aging of agricultural labor intensifies. Data from the Seventh National Population Census (2020) show the aging rate of China's agricultural laborers reached 28.3%, significantly higher than the national aging rate (18.7%) and that of all employed persons (8.8%), indicating profound implications for agricultural production.

The phenomenon of rural elderly individuals persistently engaging in farming within contemporary Chinese villages is, in essence, a result of the mutual construction of objective labor capacity and structural demand. Compared to traditional agricultural societies, the conditions under which contemporary elderly individuals engage in agricultural production have undergone significant changes. Firstly, according to the latest statistical results released by the National Health Commission at the press conference on people's livelihoods during the third session of the 14th National People's Congress, China's average life expectancy reached 79 years in 2024. Furthermore, research indicates that the rate of complete loss of functional ability among the rural Chinese population at age 80 is merely 15.5% [12], signifying that the rural population retains relatively strong labor capacity during old age; secondly, the coverage rate of mechanization in agricultural production has substantially increased, particularly in grain-producing plains regions, where the substitution of large machinery for labor has rendered the physical demands of agricultural activities extremely low [13]. Macroscopically, rural elderly thus remain key actors in current agricultural production. Conversely, young rural disinterest in farming hindered land transfer mechanisms, leaving elders to self-cultivate or abandon land, and social security gaps create structural reliance on elderly labor.

Discussions within the academic community regarding the issue of "elderly agriculture" have predominantly concentrated within the realm of agricultural economics, that is, treating elderly farming as an agricultural production phenomenon, making efficiency judgments about it, and thereby reflecting on the developmental impasse of Chinese agriculture. Existing research posits that rural population aging reduces agricultural production efficiency, exerting significant negative effects on both agricultural labor input and agricultural output[14–20], with the cultivated land area, production input, and marginal output of rural elderly individuals being lower than those of younger farmers, which restricts agricultural development and threatens the sustainability of smallholder farming; elderly farming may even alter the mode of intensive and meticulous cultivation, leading to phenomena such as extensive management and land abandonment[21–23]. Conversely, other scholars argue that rural population aging does not harm production, positing that the elderly proportion can have a positive influence on technical efficiency variation[24–26]. As workers engaged in agricultural production activities age, they continually accumulate cultivation experience, and their labor skills gradually improve, thereby enhancing agricultural production efficiency[27,28].

In recent years, some scholars have begun to focus on the social value of "elderly agriculture", emphasizing that "elderly agriculture" does not signify the end of agriculture; rather, under sufficient external conditions such as agricultural socialized services and village public services, "elderly agriculture" not only contributes to agricultural production but also helps reduce the societal cost of aging[29]. "Elderly agriculture" can also facilitate the reproduction of village culture and the meaning of life, holding significant importance for the development of peasant families and the stability of rural society[30], consequently enabling villages to continuously function as a "reservoir" for surplus labor[31]. Rural elderly individuals can also utilize land for old-age support, realizing the security function of land[32]. The discussion on the social value of "elderly agriculture" not only achieves a high degree of integration between agricultural production modes and structural factors such as population aging, rural family-based eldercare models, and farmland institutional arrangements, but also relatively breaks through the efficiency paradigm of agricultural research, further broadening the social implications of "elderly agriculture". However, the aforementioned studies still neglect the complexity and differentiation within the rural elderly population itself, as well as overlook the agency of the elderly in engaging in agricultural production, thus remaining deficient in qualitative presentation and in-depth interpretation of the phenomenon of "elderly farming." In summary, existing research findings exhibit an insufficient quantity and lack of comprehensiveness concerning the study of rural elderly participation in agricultural production, failing to describe the mechanisms underlying the occurrence of rural elderly individuals' engagement in agricultural labor. Therefore, this study breaks through the efficiency debate surrounding "whether they should labor" and turns towards investigating the generative mechanism of "why they persistently labor", proposing the core research question: Against the irreversible backdrop of aging, what are the key factors driving the sustained participation of rural elderly individuals in agricultural labor? This study utilizes data from the China Longitudinal Aging Social Survey (CLASS) in 2016, 2018, and 2020 to examine the impact of agricultural labor participation on elderly rural residents.

To better understand the persistent engagement of elderly individuals in agricultural labor, this study draws upon two complementary theoretical paradigms. According to the active aging framework proposed by the World Health Organization, social participation of older adults is one of the three pillars of active aging. It serves as both a crucial pathway for maintaining their connection with society and an important indicator reflecting the level of social development. The framework posits that "active aging" is determined by multiple factors, including individual attributes, behaviors, health and social services, economic conditions, as well as social and physical environments.

The concept of "productive aging", first introduced by American gerontologist Robert N. Butler in 1982, views older adults as valuable resources for society. It emphasizes enabling them to achieve a longer, healthier life expectancy and enrich their human capital, while

advocating for their effective integration and participation in activities that generate sustained contributions to families, communities, and society at large [33–35]. Chinese scholars argue that the Western concept of "productive aging" is equivalent to the notion of "Lao You Suo Wei" (meaning "aging with purpose and contribution") advocated in China, and that these two terms can be used interchangeably in the Chinese context [36,37]. Morrow-Howell et al. [38] conducted a review of theories such as activity theory, successful aging, and productive aging, further expanding the conceptual framework of active aging to develop a research model on older adults' social participation patterns. Within this research framework, the factors influencing older adults' participation patterns were categorized into individual factors (e.g., gender, age), economic factors (e.g., household income, family assets), social factors (e.g., household size, number of children), and environmental factors (e.g., urban/rural residence, neighborhood relationships). Similarly, Bass [39] and colleagues identified four groups of influencing factors based on the "productive aging" conceptual framework: individual factors (e.g., motivation, attitudes, gender), contextual factors (e.g., roles, responsibilities, health, family circumstances), environmental factors (e.g., economic conditions, cultural norms, age cohort), and social policy factors (e.g., employment policies, pension systems).

Building on these existing models and considering the specific context of rural China, this study modifies and extends the framework to propose an analytical model for factors influencing rural elderly participation in agricultural labor (**Figure 1**).

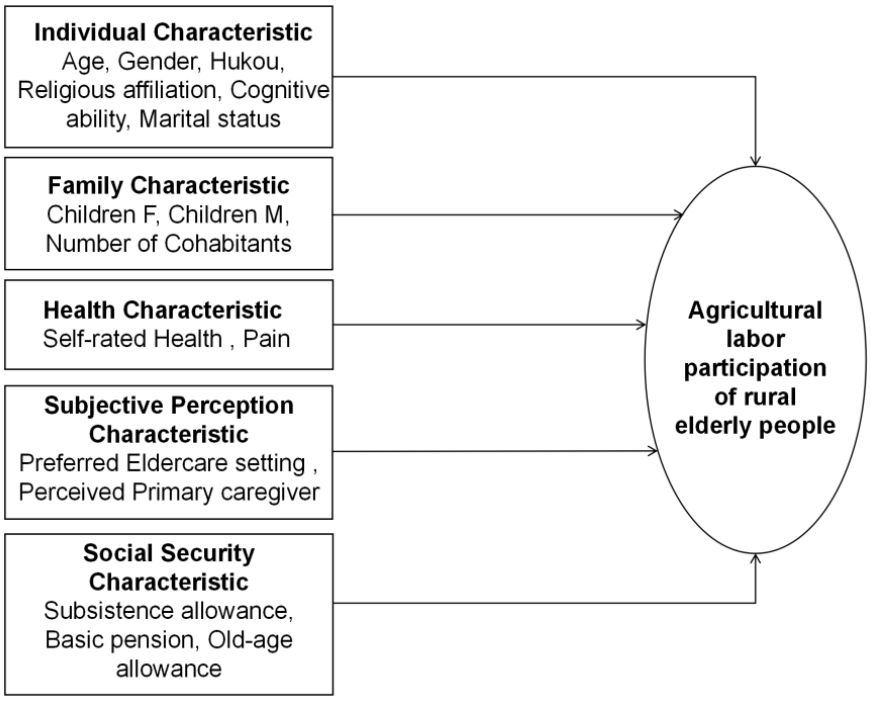

Figure 1. An analysis framework for determinants of agricultural labor participation of rural elderly people in China.

Based on the theoretical frameworks of active aging and productive aging, combined with the contextual realities of rural China, this study proposes the following hypotheses:

H1. *Health-enabled labor participation hypothesis.*

The health status of rural elderly individuals is positively associated with their participation in agricultural labor, where better self-rated health significantly predicts a higher likelihood of engagement in farming activities.

H2. *Autonomous elderly participation hypothesis.*

Elderly individuals with stronger preferences for independent eldercare (self- or spouse-supported) show significantly higher agricultural labor participa-

tion rates compared to those relying on family or institutional support.

H3. *Social security substitution hypothesis.*

Access to social security benefits is associated with reduced agricultural labor participation among rural elderly, suggesting potential income effects.

2. Materials and Methods

2.1. Model Construction

This study focuses on agricultural labor participation among elderly rural residents, treated as a binary discrete choice variable coded as 1 if the individual participates and 0 otherwise. Given the discrete nature of the dependent variable, a logistic regression model is employed to estimate the log-odds of participation as a function of individual, household, health, perceptual, and social security characteristics. Logistic regression is widely used in studies of labor market behavior and rural household decisions because the predicted probabilities obtained via the inverse-logit function lie in the range of 0–1, and effects can be interpreted as odds ratios.

Formally, the log-odds of agricultural labor participation are modeled as:

$$logit\left(P_i\right) = ln\left(\frac{P_i}{1-P_i}\right) = a_0 + \beta^{'} X_i + \delta_t + \mu_p + \varepsilon_i \quad (1)$$

where $P_i = Pr\left(y_i = 1 \mid X_i\right)$ is the probability that an individual i participates in agricultural labor, given covariates X_i. X_i collects covariates motivated by the theoretical framework (individual, family, health, subjective perception, and social security characteristics); β is the parameter vector; δ_t and μ_p denotes year and province fixed effects; and ε_i is an idiosyncratic error term. Equation (1) is estimated by maximum likelihood. Coefficients are interpreted on the log-odds scale; exponentiating elements of β yields odds ratios.

Corresponding probabilities are recovered via the inverse-logit:

$$P_i = \frac{1}{1 + exp(-(a_0 + \beta^{'} X_i + \delta_t + \mu_p))} \quad (2)$$

To enhance robustness and address potential methodological concerns, we adopted several additional procedures. Observations with missing values were excluded from the analysis. To reduce omitted-variable bias, we controlled for a broad range of demographic and socioeconomic factors and introduced year and province fixed effects to capture regional heterogeneity. Variance inflation factors (VIFs) were calculated to assess multicollinearity, with results indicating no serious issues. Finally, heteroskedasticity and intra-village correlation were addressed by employing robust clustered standard errors.

2.2. Data

The data in this study are from the 2016, 2018, and 2020 CLASS. CLASS is a nationwide, continuous, large-scale social survey project designed and implemented by Renmin University of China. It aims to provide a comprehensive understanding of the basic situation, living conditions, and needs of the elderly; a stratified multi-stage likelihood sampling method is further used to obtain data from11,511 (2016), 11,419 (2018), and 11,413 (2020) older adults in 28 provinces, municipalities directly under the Central Government control and autonomous regions (excluding Hong Kong, Taiwan, Macau, Hainan, Xinjiang, and Xizang). Considering the absence of variables, 12,263 older adults were selected after eliminating missing samples.

2.3. Variable Selection

2.3.1. Dependent Variables

The dependent variable in this study is participation in agricultural labor by elderly rural residents, defined as a binary variable with two discrete outcomes: “yes” or “no”. Specifically, participation in agricultural work is coded as 1, while non-participation is coded as 0.

2.3.2. Explanatory Variables

Based on the theoretical framework of this study, the explanatory variables encompass the individual characteristic variables, family characteristic variables, health characteristic variables, subjective perception characteristic variables, and social security characteris-

tic variables pertaining to the rural elderly population. Among these, the individual characteristic variables include Age, Gender, Hukou, Religious affiliation, Cognitive ability, and Marital status. The family characteristic variables comprise the number of children (Children F and Children M) and the number of Cohabitants. The health characteristic variables consist of self-rated Health and the experience of bodily Pain. The subjective perception characteristic variables include the preferred Eldercare setting and the perceived Primary caregiver. The social security characteristic variables incorporate coverage by the Subsistence allowance, coverage by the Basic pension, and coverage by the old-age allowance. Additionally, the province was incorporated as a fixed effect. The coding assignment and descriptive statistics for each variable are presented in **Table 1**.

Table 1. Summary statistics.

Variable	Definition	Mean	S.D.
Agri-work	Dummy variable (Engaged in agricultural work = 1; Not engaged in agricultural work = 0)	0.298	0.458
Age	Age of the elderly	71.241	7.111
Gender	Dummy variable (male = 1; female = 0)	0.535	0.499
Hukou	Household registration (Agricultural hukou = 1; Non-agricultural hukou = 0)	0.922	0.268
Religious affiliation	Buddhism = 1; Taoism = 2; Protestantism = 3; Catholicism = 4; Islam = 5; Other religions = 6	0.066	0.249
Cognitive ability	Cognitive ability was measured using a series of cognitive items from the survey questionnaire, with a total score ranging from 0 to 16. Higher scores indicate better cognitive performance.	10.005	4.664
Marital status	Married with spouse = 1; widowed = 2; divorced = 3; never married = 4	1.323	0.541
Children F	Number of living daughters	1.36	1.121
Children M	Number of living sons	1.568	1.015
Cohabitants	Total persons living with the respondent, including the respondent	2.684	1.305
Health	Self-rated health Measured on a 5-point Likert scale (Lower scores indicate better health status)	2.75	0.978
Pain	Dummy variable Body pain experience in the last 30 days (Experienced bodily pain = 1; No bodily pain = 0)	0.448	0.497
Eldercare setting	Preferred eldercare setting: Own home = 1; Children's home = 2; Community daycare center = 3; Nursing home = 4; Undecided = 5; Other = 6	2.732	2.466
Primary caregiver	Perceived primary caregiver: Government = 1; Society = 2; Children = 3; Self or spouse = 4; Shared responsibility = 5	3.399	2.126
Old-age allowance	Dummy variable (Covered by old-age allowance = 1; No coverage = 0)	0.343	0.475
Subsistence allowance	Dummy variable (Covered by subsistence allowance = 1; No coverage = 0)	0.084	0.278
Basic pension	Dummy variable (Covered by basic pension = 1; No coverage = 0)	0.605	0.489
Year	Survey year (2016, 2018, 2020)	2,018.055	1.637

3. Empirical Results and Interpretation

3.1. Logit Regression Results

Before presenting the Logit regression results, we conducted pairwise Pearson correlation analyses to assess potential multicollinearity among the independent variables. While certain variable pairs—such as age and old-age allowance, or cognitive ability and primary caregiver—exhibited moderate correlations, the majority of coefficients were below 0.5, with the highest being approximately 0.43. According to Dormann et al. [40], a commonly accepted threshold is |0.7|, above which multicollinearity may significantly distort model estimates. As none of the correlation coefficients in our analysis approached this threshold, we conclude that multicollinearity does not pose a substantial threat to the reliability of our regression results.

Based on CLASS data from 2016, 2018, and 2020 (N = 12,263), this study systematically identified the factors associated with rural elderly individuals' participation in agricultural labor using two sets of Logit models, with the results presented in **Table 2**. In both models, the dependent variable is whether the respondent engaged in agricultural labor (Agri-work = 1). Model 1 includes key explanatory variables such as individual characteristics, family structure, and health status. Model 2 extends the specification by incorporating province fixed effects to control for unobserved regional heterogeneity—such as differences in agricultural policy, climate, and infrastructure—thereby enhancing the robustness of the estimation.

Table 2. Determinants of agricultural labor participation: logit regression results.

	Model 1		**Model 2**	
Variable	**Agri-Work**		**Agri-Work**	
Age	−0.0883***	(−18.80)	−0.0954***	(−19.07)
Gender	0.127**	(2.83)	0.173***	(3.57)
Hukou	1.774***	(14.18)	1.809***	(12.95)
Religious affiliation	−0.492***	(−4.78)	−0.258*	(−2.21)
Cognitive ability	0.0627***	(7.00)	0.0260**	(2.83)
Marital status (Married with spouse REF)				
Widowed	−0.0388	(−0.72)	−0.0569	(−0.99)
Divorced	−0.412	(−1.33)	−0.447	(−1.20)
Never married	0.427	(1.55)	0.195	(0.77)
Children F	0.155***	(7.56)	0.0830***	(3.69)
Children M	0.156***	(6.50)	0.0624*	(2.37)
Cohabitants	−0.00438	(−0.25)	−0.0434*	(−2.27)
Health	−0.190***	(−7.52)	−0.208***	(−7.48)
Pain	0.186***	(4.04)	0.0690	(1.37)
Eldercare setting (Own home REF)				
Children's home	−0.417***	(−6.53)	−0.506***	(−7.43)
Community daycare center	−0.288*	(−2.31)	−0.339**	(−2.60)
Nursing home	−0.255	(−1.75)	−0.243	(−1.63)
Undecided	0.344***	(4.85)	−0.0563	(−0.73)
Other	−0.301	(−0.35)	0.791	(0.84)
Primary caregiver (Government REF)				
Society	−0.0807	(−0.93)	0.0282	(0.31)
Children	−0.421***	(−4.70)	−0.384***	(−3.89)
Self or spouse	−0.122	(−1.08)	−0.170	(−1.36)
Shared responsibility	−0.258**	(−3.09)	−0.440***	(−4.70)
Old-age allowance	0.424***	(6.88)	0.435***	(6.57)
Subsistence allowance	0.118	(1.37)	−0.173	(−1.69)
Basic pension	0.432***	(9.02)	0.306***	(5.40)
Year (2016 REF)				
2018	2.253***	(24.51)	2.264***	(23.60)
2020	1.387***	(13.38)	1.781***	(14.89)
Province fixed effects			**YES**	
_Cons	1.440***	(3.77)	1.890***	(4.63)
N	12263		12202	

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$: t statistics in parentheses. The dependent variable in both Model 1 and Model 2 is a binary indicator of agricultural labor participation (Agri-work = 1). Model 2 additionally controls for Province fixed effects to account for regional heterogeneity.

The empirical results indicate that, regarding individual characteristic variables, age showed a significant negative association with agricultural labor participation in both models (coefficients: −0.088 to −0.095, $p < 0.001$). Male respondents consistently showed higher participation rates than females, with the coefficient increasing from 0.127 (Model 1) to 0.173 (Model 2) after incorporating regional fixed effects. Agricultural Hukou maintained a strong positive association across specifications (coefficients: 1.774–1.809, $p < 0.001$). Religious affiliation showed a negative association that remained significant though attenuated in Model 2 (from $p < 0.01$ to $p < 0.05$). Cognitive ability demonstrated a positive association in both models, though the effect weakened in Model 2 (from $p < 0.001$ to $p < 0.01$).

Concerning family characteristic variables, both the number of daughters and the number of sons showed positive associations, though these effects weakened substantially after regional controls. The coefficient for daughters decreased from 0.155 (Model 1) to 0.083 (Model 2), while for sons it dropped from 0.156 to 0.062. The number of cohabitants showed a significant negative association only in Model 2 (coefficient: −0.043, $p < 0.05$).

Regarding health characteristic variables, Hypothesis 1 predicted that better health would be associated with increased labor force participation. Better self-rated health maintained a strong positive association

across both models (coefficients: −0.190 to −0.208, $p < 0.001$). The pain experience variable showed a positive association in Model 1 (coefficient: 0.186, $p < 0.001$) that became insignificant in Model 2. Potential reasons include the possibility that elderly individuals experiencing bodily pain may be doing so because they are still engaged in labor (reverse causality), or that the Pain variable measures experiences over a past period, while labor participation refers to the current situation. The analysis of self-rated health data provided support for H1.

Considering subjective perception characteristic variables, Hypothesis 2 predicted that rural elderly with stronger independent elderly care awareness would be more likely to engage in agricultural labor. Those preferring care in their children's homes showed significantly lower labor participation than those preferring their own homes (coefficients: −0.417 to −0.506, $p < 0.001$). Similarly, expecting children as primary caregivers was negatively associated with participation compared to expecting government support (coefficients: −0.384 to −0.421, $p < 0.001$). Preferences for community daycare and shared care responsibility also showed significant negative effects, reinforcing the notion that a greater reliance on family or institutional care correlates with reduced agricultural labor engagement. The regression results supported H2.

Examining social security characteristic variables, Hypothesis 3 predicted that rural elderly individuals receiving social security benefits would be less likely to participate in agricultural labor. Contrary to predictions, both old-age allowance (coefficients: 0.424–0.435, $p < 0.001$) and basic pension (coefficients: 0.306–0.432, $p < 0.001$) were positively associated with agricultural labor participation. One possible explanation is that these benefits may improve recipients' health and living conditions, thereby enabling them to continue working. Alternatively, pension amounts may reflect past contributions, and those who contributed more may also be more inclined to remain active. The subsistence allowance showed no significant effect on labor participation. Hypothesis 3 was not supported.

3.2. Robustness Checks

To test the robustness of our main findings, we conducted a series of additional regressions using alternative dependent variables and modified samples. Specifically, Model 3 estimates a baseline Logit regression with the original set of independent variables and uses "Work" (working = 1; not working = 0) as the dependent variable. Model 4 builds upon Model 3 by incorporating province fixed effects to account for unobserved regional heterogeneity—such as differences in policy, infrastructure, and climate. Model 5 restricts the sample to respondents engaged in agricultural work and further includes economic condition variables (log_income and log_expand), which were excluded from the main models due to high rates of missing data.

To further examine the sensitivity of the estimation results to variable and sample specifications, we conducted robustness checks through alternative model configurations. First, Models 3 and 4 assess the consistency of the findings by substituting the dependent variable with general employment status, with Model 4 additionally controlling for province fixed effects. Second, Model 5 employs a reduced sample of agricultural workers and incorporates economic condition variables to assess the robustness of the results against omitted variable bias. The estimation results across all three models in **Table 3** consistently indicate that individual characteristics, family structure, health status, subjective perceptions, and social security factors remain statistically significant predictors of labor participation. These findings reinforce the robustness and reliability of the baseline regression results.

Table 3. Robustness checks via dependent variable substitution and sample modification.

	Model 3		**Model 4**		**Model 5**	
Variable	**Any Work**		**Any Work**		**Agri-Work**	
Age	−0.0931***	(−20.20)	−0.0978***	(−20.08)	−0.0865***	(−12.52)
Gender	0.219***	(4.98)	0.269***	(5.73)	0.167*	(2.26)
Hukou	1.101***	(11.09)	1.099***	(9.84)	1.625***	(7.68)
Religious affiliation	−0.267**	(−2.89)	−0.0880	(−0.83)	−0.0117	(−0.07)

Table 3. *Cont.*

	Model 3		Model 4		Model 5	
Variable	**Any Work**		**Any Work**		**Agri-Work**	
Cognitive ability	0.0585***	(6.89)	0.0312***	(3.56)	0.0154	(0.90)
Widowed	−0.0647	(−1.23)	−0.0869	(−1.56)	−0.00753	(−0.09)
Divorced	−0.575	(−1.86)	−0.528	(−1.37)	−1.547**	(−2.96)
Never married	0.146	(0.53)	−0.0414	(−0.16)	−0.323	(−0.70)
Children F	0.133***	(6.60)	0.0654**	(2.96)	0.0377	(1.08)
Children M	0.133***	(5.67)	0.0430	(1.67)	−0.0144	(−0.36)
Cohabitants	0.00996	(0.60)	−0.0270	(−1.47)	−0.0288	(−0.80)
Health	−0.251***	(−10.20)	−0.268***	(−10.10)	−0.175***	(−4.02)
Pain	0.149***	(3.33)	0.0252	(0.52)	0.114	(1.48)
Children's home	−0.401***	(−6.54)	−0.458***	(−7.08)	−0.594***	(−6.16)
Community daycare center	−0.111	(−0.91)	−0.115	(−0.91)	−0.470	(−1.22)
Nursing home	−0.0617	(−0.45)	−0.0247	(−0.17)	−0.411	(−1.30)
Undecided	0.394***	(5.60)	0.0111	(0.15)	−0.547**	(−3.02)
Other	−0.314	(−0.37)	0.289	(0.33)	0	(.)
Society	−0.0764	(−0.89)	0.0311	(0.35)	0.0933	(0.35)
Children	−0.459***	(−5.26)	−0.433***	(−4.58)	−0.493**	(−2.84)
Self or spouse	−0.129	(−1.19)	−0.170	(−1.44)	−0.209	(−1.06)
Shared responsibility	−0.305***	(−3.73)	−0.484***	(−5.37)	−0.527**	(−3.02)
Old-age allowance	0.421***	(7.02)	0.395***	(6.18)	0.513***	(4.51)
Subsistence allowance	0.116	(1.36)	−0.157	(−1.57)	−0.175	(−1.09)
Basic pension	0.386***	(8.32)	0.228***	(4.23)	0.488***	(5.03)
log_expand					−0.113*	(−2.37)
log_income					0.0883**	(3.17)
Province fixed effects			**YES**		**YES**	
Year (2016 REF)						
2018	2.097***	(24.64)	2.131***	(23.97)	2.349***	(15.77)
2020	1.149***	(11.48)	1.499***	(13.40)	0.881***	(3.49)
_Cons	2.992***	(8.28)	3.151***	(8.13)	1.216	(1.66)
N	12263		12202		5912	

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; t statistics in parentheses. Model 3 is the baseline Logit regression using "working (1 = employed)" as the dependent variable. Model 4 adds province fixed effects. Relative to Model 2, Model 5 further includes economic factors (log_income and log_expand). (.) indicates the variable was omitted due to lack of independent variation.

3.3. Heterogeneity Analysis

To explore potential heterogeneity in the effects across different population subgroups, this study conducts heterogeneity analyses from the perspectives of employment status (agricultural work vs. non-working), employment types (agricultural work vs. non-agricultural work), and subjective eldercare perceptions among agricultural workers (preferring self/children-based support vs. government/society-based support).

3.3.1. Heterogeneity Analysis by Employment Situation

As presented in Model 6 of **Table 4**, this study classified respondents' employment status into engaged in agricultural work and non-working (agricultural work = 1; not working = 0) for analysis. As shown in Model 7 of **Table 4**, this study further classified respondents' employment status into agricultural work versus non-agricultural work (agricultural work = 1; non-agricultural work = 0), analyzing differential patterns in agricultural labor participation among rural elderly individuals.

The results indicate that, regarding individual characteristic variables, older age is associated with a significantly decreased likelihood of rural elderly individuals engaging in agricultural work compared to non-working status (Model 6), whereas this association is non-significant when compared to engagement in non-agricultural work (Model 7). Model 6 demonstrates that male rural elderly individuals exhibit a higher probability of engaging in agricultural work than females; however, Model 7 reveals that among all employed rural elderly individuals, males show a higher propensity for non-agricultural work.

Concerning family characteristic variables, both Models 6 and 7 demonstrate that a greater number of daughters (Children F) is associated with an increased likelihood of rural elderly individuals participating in agricultural labor. The number of sons (Children M) shows a significant positive association in Model 6 but remains non-significant in Model 7.

Table 4. Heterogeneity analysis.

	Model 6		Model 7		Model 8		Model 9	
Variable	**Agric-Workless**		**Agric-Nonagriwork**		**Children, Self, or Spouse**		**Government-Society**	
Age	−0.100***	(−19.62)	0.00110	(0.06)	−0.106***	(−10.97)	−0.0917***	(−11.01)
Gender	0.226***	(4.59)	−0.449**	(−3.27)	0.0836	(1.05)	0.179*	(2.10)
Hukou	1.732***	(12.34)	2.549***	(9.37)	2.005***	(9.68)	1.562***	(6.19)
Religious affiliation	−0.157	(−1.33)	−0.708**	(−2.76)	−0.577**	(−2.96)	0.0960	(0.52)
Cognitive ability	0.0275**	(2.95)	−0.0445	(−1.45)	0.00837	(0.62)	0.0536**	(3.05)
Marital status (Married with spouse REF)								
Widowed	−0.0723	(−1.25)	0.312	(1.68)	−0.108	(−1.15)	−0.0834	(−0.81)
Divorced	−0.520	(−1.37)	0.496	(0.53)	0.0499	(0.09)	−0.386	(−0.49)
Never married	0.118	(0.46)	0	(.)	0.127	(0.31)	0.629	(1.45)
Children F	0.0803***	(3.50)	0.222**	(2.71)	0.114**	(3.10)	0.0295	(0.73)
Children M	0.0647*	(2.41)	0.187	(1.74)	0.104*	(2.37)	−0.00353	(−0.08)
Cohabitants	−0.0356	(−1.83)	−0.147**	(−2.87)	−0.0546	(−1.75)	−0.0533	(−1.51)
Health	−0.243***	(−8.63)	0.248**	(3.03)	−0.247***	(−5.22)	−0.164***	(−3.45)
Pain	0.0566	(1.11)	0.229	(1.60)	0.0226	(0.27)	0.268**	(2.90)
Eldercare setting (Own home REF)								
Children's home	−0.510***	(−7.44)	−0.341	(−1.70)	−0.204	(−1.45)	−0.393***	(−3.85)
Community daycare center	−0.282*	(−2.13)	−1.075***	(−3.55)	−0.259	(−1.61)	−0.512	(−1.20)
Nursing home	−0.170	(−1.11)	−1.187***	(−3.58)	−0.261	(−1.26)	−0.438	(−1.11)
Undecided	−0.0358	(−0.45)	−0.282	(−1.32)	−0.309**	(−2.94)	0.283	(0.94)
Other	0.690	(0.77)	0	(.)	1.044	(0.95)	—	—
Primary caregiver (Government REF)								
Society	0.0319	(0.34)	−0.0939	(−0.39)	—	—	—	—
Children	−0.416***	(−4.15)	0.126	(0.47)	—	—	—	—
Self or spouse	−0.159	(−1.26)	−0.250	(−0.81)	—	—	—	—
Shared responsibility	−0.466***	(−4.90)	−0.0327	(−0.13)	—	—	—	—
Old-age allowance	0.440***	(6.51)	0.239	(1.26)	0.357**	(3.15)	0.709***	(5.91)
Subsistence allowance	−0.188	(−1.80)	0.0866	(0.30)	−0.0102	(−0.06)	−0.293	(−1.69)
Basic pension	0.307***	(5.33)	0.621***	(4.10)	0.133	(1.41)	0.294**	(2.86)
Year (2016 REF)								
2018	2.331***	(24.07)	0.382	(1.37)	1.107***	(3.72)	1.987***	(13.60)
2020	1.789***	(14.77)	1.172***	(4.23)	1.182***	(4.51)	0.538	(1.86)
Province fixed effects	YES		YES		YES		YES	
_Cons	2.324***	(5.61)	−0.231	(−0.18)	3.643***	(4.79)	0.810	(1.18)
N	11810		3970		4137		4510	

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; t statistics in parentheses. (.) indicates the variable was omitted due to lack of independent variation.

For health characteristic variables, Model 6 indicates that when rural elderly individuals are in poorer health (higher scores on the self-rated Health scale), they are more likely to be non-working rather than engaged in agricultural work. In Model 7, among all employed rural elderly individuals, those in poorer health exhibit a reduced probability of engaging in agricultural work.

3.3.2. Heterogeneity Analysis by Subjective Eldercare Perceptions

As presented in Models 8 and 9 of **Table 4**, this study classifies respondents' subjective perceptions of eldercare into two categories: preferring self/child-based eldercare (1) and preferring government/society-based eldercare (0), to analyze differential patterns in agricultural labor participation among rural elderly individuals. The results indicate that, regarding individual characteristic variables, in Model 9, among rural elderly individuals who prefer government or society-based eldercare, males exhibit a significantly higher probability of engaging in agricultural work compared to females, while Cognitive ability shows no significant association. In Model 8, gender demonstrates no significant influence, but individuals with higher Cognitive ability display a greater probability of engaging in agricultural labor. Concerning family characteristic variables, Model 8 indicates that a greater number of both daughters (Children F) and sons (Children M) is associated with an increased likelihood of engaging in agricultural work. In Model 9, however, among rural elderly individuals who prefer government or society-based eldercare, neither

Children F nor Children M shows a significant association. For health characteristic variables, Model 9 demonstrates that rural elderly individuals who prefer government or society-based eldercare and experience bodily Pain exhibit a higher probability of participating in agricultural work (reverse causality), whereas in Model 8, Pain exerts no significant association. Examining subjective eldercare perception characteristic variables, Model 9 reveals that elderly individuals who prefer to be cared for in children's homes have a significantly lower probability of participating in agricultural work compared to those who prefer their own home; however, in Model 8, the perceived Primary caregiver shows no significant association.

Regarding social security characteristic variables, Model 9 reveals that among rural elderly individuals who prefer government or society-based eldercare, those covered by the Basic Pension exhibit a higher probability of engaging in agricultural work, whereas in Model 8, the Basic Pension shows no significant association.

4. Discussion

The analytical results demonstrate that health status is a significant factor associated with participation in agricultural work among rural elderly individuals. Elderly individuals with better self-rated health were found to have a higher likelihood of engaging in agricultural work, aligning with findings from domestic scholars. Wu's empirical analysis of rural Jiangsu Province concluded a positive relationship between health status and agricultural labor participation among rural elderly [41]. Yang et al. found that chronic health shocks reduce the agricultural labor time of rural elderly individuals but do not compel them to abandon agricultural work itself due to livelihood pressures, whereas acute health shocks directly affect labor participation; health shocks themselves impact labor productivity [42]. Scholars have identified linkages among health level, labor participation, and elderly poverty, noting that health level influences labor quality and the extent of participation, thereby affecting actual poverty levels through economic income and mental state. Compared to urban residents with comprehensive security systems, rural residents are more significantly impacted by health levels, leading to the conclusion that "health shows a clear positive association with residents' labor participation, and rural elderly residents are more significantly affected than other groups; health influences welfare rates among rural elderly residents" [43]. As a core element of human capital, health deserves increased emphasis in the development of social security and healthcare systems.

A noteworthy finding is the strong association between the subjective perceptions of eldercare among rural elderly individuals and their participation in agricultural work. Those preferring to be cared for in their own home were significantly more likely to be engaged in agricultural labor than other groups. This tendency can be interpreted through the lens of agricultural production as a means of providing self-reliant support for old age. Supported by agricultural production, elderly individuals generally require no eldercare responsibility from their children. Only when they have completely lost their agricultural production capacity do they necessitate financial support from their offspring. At this stage, children provide sustenance "according to conscience", while the elderly adopt "spousal cohabitation with mutual care". Most elderly minimize economic demands, maintaining basic subsistence levels to preserve economic surplus for offspring. Only when approaching end-of-life dependency do they fully rely on sons' support. This implies that, although dual eldercare options exist, land-based self-support remains the primary mode of care during old age. Given exorbitant urban living costs, offspring's income sustains only basic needs, leaving them unable to provide comprehensive care for their elders. Consequently, offspring typically provide auxiliary support—transferring land resources or supplementing agricultural labor—rather than monetary care. Such support constitutes indirect supplementation to self-reliance. Amidst waning generational support, rural elderly shoulder greater pressures to seek stable self-support pathways. Improved agricultural technology enhances independent farming capacity, thereby fulfilling self-sustaining needs. Thus, "elderly agriculture" not only alleviates potential care crises but also sustains

autonomous living among vulnerable elderly, serving a critical role in realizing family-based eldercare.

Lastly, social security coverage is significantly associated with participation in agricultural work. Receiving an Old-Age allowance or Basic Pension is associated with an increased likelihood of participation. Academic conclusions remain inconsistent: Liu and Liu [44] found pension security's "income effect" outweighs "substitution effect", reducing labor participation; Liu [45] observed pension insurance increases participation likelihood. Other studies indicate that pension coverage reduces employment likelihood, with limited effects [46,47]. Crucially, persistent rural-urban economic disparities limit household financial accumulation. In 2024, China's per capita disposable income reached 41,314 CNY, with rural residents at 23,119 CNY. Despite expanding coverage, absolute social security levels remain insufficient to meet the needs of rural elderly populations. Consequently, land remains fundamental to livelihood security, and the elderly continue agricultural labor while retaining their work capacity.

5. Conclusion

This study employed three waves of the China Longitudinal Aging Social Survey (CLASS) data within the theoretical frameworks of active aging and productive aging, and utilized Logit regression models to examine the influence of various factors on the participation of rural elderly individuals in agricultural production work. Robustness checks were conducted by substituting the dependent variable and altering the sample, alongside heterogeneity analyses. The empirical results indicate that individual characteristic variables, family characteristic variables, health characteristic variables, subjective perception characteristic variables, and social security characteristic variables all exert a statistically significant influence on the agricultural labor participation of rural elderly individuals, demonstrating robust findings. Specifically, being male, possessing agricultural Hukou, higher Cognitive ability, a greater number of children (both daughters and sons), better self-rated health, experiencing bodily pain, preferring to be cared for in one's own home (Eldercare setting), and receiving either the Old-Age allowance or the Basic Pension all display a significant positive influence on participation in agricultural labor.

Health status is a key predictor of labor participation of the elderly. While elderly individuals typically exit the labor force due to poor health, many continue working as long as their physical condition permits. However, instances remain where some rural elderly engage in persistent, potentially indefinite labor due to economic pressures or familial obligations. Therefore, policy efforts should prioritize enhancing human capital investment in rural areas, particularly improving medical security mechanisms for middle-aged and elderly populations. When formulating social security policies, optimizing the contribution and benefit mechanisms of pension insurance is paramount. This must balance the incentive to contribute with the avoidance of indiscriminate elevation of pension benefit levels, thereby fostering an environment that supports both the sustainable development of pension insurance and a positive, effective labor supply among the elderly. Additional policy support should be directed to the impoverished elderly to prevent survival-driven overwork.

For rural elderly individuals who exhibit strong preferences for self-based eldercare, engagement in agricultural production is strongly linked to an extended capacity for self-reliant old-age support. Income derived from agricultural activities signifies not merely the fulfillment of economic and livelihood requirements but crucially enables the elderly to accomplish personal life tasks through agricultural labor and derive a sense of meaning. Accordingly, agricultural policies should reinforce the protection of land management rights to ensure land serves as a key productive resource for elderly farmers. Simultaneously, relaxing restrictions on land adjustments can facilitate agricultural cultivation and machinery usage by rural elderly individuals appropriately. Furthermore, the advancement of agricultural modernization must not overlook the welfare of smallholder farmers. Ensuring accessible agricultural production conditions is crucial to maintaining the sustainability of elderly smallholders and supporting their healthy and dignified aging.

6. Limitations and Future Research

This study has several limitations that warrant acknowledgment. First, the reliance on self-reported measures (e.g., health status) may introduce subjective bias. Future research could integrate objective health indicators to improve validity. Second, economic variables were limited by missing data, which prevented their inclusion in primary models. More complete economic data collection and mixed-methods approaches are recommended to clarify underlying mechanisms and contextual factors. Third, despite identifying robust associations, unobserved confounders and potential reverse causality prevent definitive causal interpretation. Subsequent studies should employ fixed-effects models or instrumental variable techniques to strengthen causal inference.

Author Contributions

Conceptualization, F.Y. and H.N.; methodology, F.Y.; validation, F.Y., L.B., and D.L.; formal analysis, F.Y.; resources, H.N.; writing—original draft preparation, F.Y.; writing—review and editing, F.Y., L.B., D.L., A.C., J.W., and H.N.; supervision, A.C., J.W., and H.N.; project administration, H.N. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

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Informed Consent Statement

Patient consent was waived due to the use of publicly available, de-identified secondary data from CLASS.

Data Availability Statement

The data used in this study are from the China Longitudinal Aging Social Survey (CLASS), which are publicly accessible upon application at http://class.ruc.edu.cn.

Conflicts of Interest

The authors declare that there is no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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