Ciência Rural, Santa Maria, v.52:11, e20210155, 2022 http://doi.org/10.1590/0103-8478cr20210155
ISSNe 1678-4596
AGRIBUSINESS

The impact of asset specificity on farmland inheritance willingness: Evidence from apple growers in China

Qiangqiang Zhang[1] Xixi Wu[2] Nazir Muhammad Abdullahi[2] Yue Wang[2] Xuexi Huo[2*]

[1]China Center for Agricultural Policy, School of Advanced Agricultural Sciences, Peking University, 100871, Beijing, China.
[2]College of Economics and Management, Northwest A&F University, Yangling 712100, China. E-mail: xuexihuo@nwsuaf.edu.cn.
[*]Corresponding author.

ABSTRACT: *Based on detailed household survey of apple farmers in Shandong and Shaanxi, this article used a binary logistic regression model to examine the impact of asset specificity on farmers' intergenerational succession arrangements of apple orchard. The results showed that the farmers' intergenerational willingness of younger generation to succeed them is generally weak. The specificity of human capital, physical assets, land assets and geographic location significantly impacted on farmers' intergenerational succession of family-operated apple orchard. Especially, the production technology level of apple planting decision-makers, the value of orchard facilities and machinery owned by apple growers, orchard topography, orchard fertility, government support, and the length of village hardened roads have significantly positive impacts on farmers' willingness. The education achievement of apple planting decision-makers, orchard irrigation area, and the number of village apple disasters negatively impacted farmers' willingness. Therefore, technical training should be intensified to effectively increase the human capital of farmers, infrastructure construction should be strengthened to improve apple production conditions, and professional farmers' operations should be supported to develop moderate-scale operations.*
Key words: *asset specificity, succession planning, apple orchard, logistic model, China*

O impacto da especificidade dos ativos na herança de terras agrícolas: evidências de produtores de maçã na China

RESUMO: *Com base em uma pesquisa domiciliar detalhada de produtores de maçã em Shandong e Shaanxi, este artigo usou um modelo de regressão logística binária para examinar o impacto da especificidade dos ativos nos arranjos de sucessão intergeracional dos produtores de pomar de maçã. Os resultados mostram que a disposição intergeracional dos agricultores da geração mais jovem para sucedê-los é geralmente fraca. A especificidade do capital humano, ativos físicos, ativos de terra e localização geográfica impactaram significativamente na sucessão intergeracional dos agricultores de pomar de maçã administrado por famílias. Especialmente, o nível de tecnologia de produção dos tomadores de decisão de plantio de maçã, o valor das instalações de pomar e maquinários de propriedade dos produtores, topografia do pomar, fertilidade do pomar, apoio do governo e a extensão das estradas da aldeia têm impactos significativamente positivos na vontade dos agricultores. As conquistas educacionais dos tomadores de decisão de plantio de maçã, a área de irrigação do pomar e o número de desastres de maçã nas aldeias impactam negativamente a vontade dos agricultores. Portanto, o treinamento técnico deve ser intensificado para aumentar efetivamente o capital humano dos agricultores, a construção da infraestrutura deve ser reforçada para melhorar as condições de produção de maçã e as operações dos agricultores profissionais devem ser apoiadas para desenvolver operações em escala moderada.*
Palavras-chave: *especificidade de ativos, planejamento de sucessão, pomar de macieiras, modelo logístico, China.*

INTRODUCTION

China is the world's largest apple producer. The United States Department of Agriculture (USDA) estimated that China's fresh apple output accounted for 53.20% of the world total in 2020 (USDA, 2021), China's apple industry has become an important part of the national fruit industry, which is also the primary agricultural development industry and the main source of income for farmers in apple producing areas (ZHANG et al.,2021; MA et al., 2018; WANG et al., 2016). However, with the advancement of urbanization in apple-producing areas, a large number of young rural laborers gradually break away from agricultural operations and turn to non-agricultural industries, which accelerates the aging of apple labor force (QIAO & HUO, 2017; LI & FAN, 2013). Under the dual population development trend of aging agricultural population and transferring rural labor force in apple-producing areas, the problem of

Received 02.25.21 Approved 12.02.21 Returned by the author 03.07.22
CR-2021-0155.R1
Editors: Leandro Souza da Silva Raquel Breitenbach

"who will plant apples in the future" is highlighted. Because the Chinese government implements the agricultural management system characterized by the household contract responsibility system, apple production is still dominated by farmers' household management (WANG & LI, 2020). Under the realistic background that farmers' farmland circulation ratio is low in the main apple producing areas (HOU & HUO, 2016), farmers' and their descendants' apple management willingness will have an important impact on sustainable apple production. Therefore, a comprehensive and in-depth understanding of farmers' intergenerational transmission willingness of apple orchard is of great significance to analyze the future development situation of apple industry in apple-producing areas, coordinate the relationship between urbanization and apple industry development, and enhance the sustainable development ability of apple.

Most scholars focus on the intergenerational transmission willingness of farmers' agricultural or grain management from academic research point of view. For example, ZHU et al. (2010) applied the intergenerational transmission theory to the intergenerational transmission analysis of farmers' rice management, and they reported that the individual characteristics, family characteristics, regional characteristics, policy support and management characteristics of farmers are the main factors affecting the intergenerational transmission of farmers' rice management. NING & NING (2016) and NIE & ZHONG (2017) believe that non-agricultural employment and individual life cycle have a significant impact on farmers' willingness to operate agriculture and intergenerational transmission. Some scholars have tried to analyze the intergenerational transmission willingness of farmers' agricultural management from the perspective of policies and systems and reported that the cultivation of agricultural successors and the support of public policies are helpful to enhance the intergenerational transmission willingness of farmers' agricultural management (LEONARD et al., 2017; SUESS-REYES & FUETSCH, 2016). The new rural social endowment insurance system has a significant role in promoting the intergenerational transmission behavior of farmers' agricultural management (ZHOU & WENG, 2017). Also, KONG et al. (2016) reported that grassland resources and labor are the main factors affecting the intergenerational transmission willingness of herdsmen's grassland animal husbandry management. Some scholars began to pay attention to the intergenerational transmission of apple management, such as ZHANG & HUO (2021) confirmed the endowment of human resources within apple household is the key factor that determined the intergenerational transmission of apple management.

Overall, the existing literature has studied the intergenerational transmission willingness of farmers' agricultural management and its influencing factors from different perspectives, which provides the theoretical and methodological basis for this study. However, there are still some shortcomings, which are as follows: the existing studies mainly focus on the intergenerational transmission willingness in the broad concept of agriculture, and the analysis of specific crop types only focuses on annual crops, such as grain, but lacks the investigation of perennial crops, such as apples. The existing studies neglected the influence of crop attribute differences on farmers' intergenerational transmission willingness in agricultural management. Specifically, unlike annual crops, apple production and management have special attributes: first, because of the perennial crops' characteristics, it usually takes 3~5 years for apple trees to bear fruit after planting, and the orchard investment in the early stage of bearing fruit is all special assets. At the same time, a large number of special machinery and facilities need to be invested in apple production, so apple production has high asset specificity. Second, due to the low mechanization degree of apple production at present, most of the apple production links still rely on labor, which leads to the low degree of farmers' concurrent employment, and the household income of farmers mainly comes from apple production, so apple growers are typically specialized farmers (HOU & HUO, 2016; FENG & HUO, 2015). In the process of specialized apple production for a long time, farmers have gradually formed strong specificity of human capital, land assets, physical assets and geographical location (LUO et al., 2008). If farmers adjust the production structure of agricultural products and transfer agricultural assets, they will face high sunk costs. In order to reduce this sunk cost, farmers who are rational people will tend to continue to engage in apple business and pass it on to their descendants. Therefore, apple production's asset specificity and specialization have a "locking effect" on farmers' apple management. Neglecting the influence of asset specificity on farmers' intergenerational transmission will limit the understanding of intergenerational transmission behavior.

Based on factors mentioned above, this study tried to answer the following two questions using the detailed household survey data of 1012 apple growers in Shandong and Shaanxi province in China:

First, what is the mechanism of the impact of asset specificity on farmers' intergenerational transmission willingness in apple orchard farm? Second, what is the influence direction and intensity of different types of assets specific to apple orchards on farmers' intergenerational transmission willingness in apple orchard farms?

Theoretical analysis

The succession of farmers' apple orchard farm is a unique form of family wealth transfer. As a pathway of wealth accumulation, apple business includes land and its contract and management rights, buildings and other facilities, orchard machinery and other equipment, knowledge related to family apple business, human capital, etc., which can be passed on to the next generation through wealth transfer (ZHOU & WENG, 2017). Therefore, this study defined the succession pathway of apple orchard as farmers' willingness to pass on the orchard, its facilities, machinery and equipment, apple management-related knowledge, and human capital to the next generation under the apple family management mode.

Williamson, a new institutional economist, put forward the concept of "asset specificity" when studying the organizational governance structure and vertical integration, which describes the allocation of assets. Asset specificity refers to the degree to which specific assets are reconfigured for other alternative purposes by other users without causing damage to the production value of assets (WILLIAMSON, 1996). The natural attributes of apple orchard and the specialization of apple production enhance its asset specificity, making apple growers face high sunk costs when they switch to other crops or engage in non-agricultural industries. With the improvement of the specialization level of apple production, this sunk cost will continue to increase, resulting in the reduction of the expected net income of farmers' agricultural production structure adjustment or non-agricultural production activities (FENG et al., 2018), and farmers based on rational motives will prefer to continue to engage in the apple business. Hence the asset specificity brought by high investment in a perennial crop and specialized production characteristics of apples will prompt farmers to continue to manage apples and pass them on from generation to generation.

WILLIAMSON (1996) believes that asset specificity includes six categories: site specificity, physical asset specificity, human capital specificity, brand asset, special asset and temporary asset specificity. On this basis, combined with the actual situation of apple production, this study divided the asset specificity related to apple production into four categories: human capital, physical asset, land asset and geographical location (FENG et al., 2018), and expounds all kinds of assets as follows.

Human capital

In the long-term apple management process, farmers learn or accumulate knowledge and experience related to apple production through a combination of technical training and "learning by doing". In order to improve apple production efficiency, yield and quality, and gradually form a strongly based on human capital, which also increases the opportunity cost and difficulty of farmers in adjusting agricultural production structure or engaging in other industries (LUO et al., 2008; FENG et al., 2018). Human capital reflects farmers' agricultural management ability, which can generally be measured by indicators, such as farmers' farming experience, years of engaging in certain agricultural products production, and the average annual time spent on agricultural production (LIN et al., 2016). In this paper, the schooling years, years of apple operation and apple production technology level of apple planting decision-makers in farmers' families were selected to represent human capital. Among them, the schooling years of apple planting decision-makers are the basis of their human capital (LI, 2009), and the years of apple operation and apple production technology level reflect their apple production experience (LIN et al., 2016). The longer the schooling years and years of apple operation, the higher the apple production technology level, the richer their accumulated apple production experience and professional knowledge, the less likely it is to switch to other crops or change careers, the more willing it is for apple growers to intergenerational transmission of apple orchard. Therefore, this study assumed that human capital specificity will positively affect farmers' willingness to transmit apple orchard to their descendants.

Physical assets

The specificity of infrastructure assets is the physical assets formed by farmers' sustained investment in apple production in order to improve apple production efficiency, which usually includes investment in agricultural production attached to orchards (such as drip irrigation or sprinkler irrigation facilities, water pits or pools, storage houses and other equipment and buildings fixed on the apple orchard farms) and investment in production tools or

equipment (such as rotary tiller, mist sprayer, fertilizer ditcher and lawnmower.) matching with the scale of apple operation. There is no separability between these physical assets and apple orchards, which is only applicable to some apple production links. It is not easy to use them for other purposes, or they will significantly depreciate when used for other purposes (LIN et al., 2016). Farmers' investment usually expresses physical assets' specificity in orchard facilities, machinery and equipment. Therefore, the "lock-in effect" caused by higher specific physical assets makes farmers continue to engage in the apple orchard and pass it on to their descendants. The specificity of physical assets is usually expressed by farmers' investment in orchard facilities, machinery and equipment (CHEN & LUO, 2017). The higher the value of apple production-specific physical assets owned by farmers, the higher the sunk costs they face, and greater incentive to secure next generation in farming. Therefore, this study assumes that physical assets specificity can enhance the intergenerational transmission willingness to succeed their parents' apple orchard.

Land asset

The specificity of land assets is mainly reflected in the topographic conditions of orchards, soil fertility and irrigation conditions, which directly affect the operating income of the orchards (LIN et al., 2016) and affects the farmers' willingness to succeed the apple orchard to the next generation. Orchards with better terrain conditions, soil fertility, and irrigation conditions offered greatly likelihood of operating income and encourage farmers to continue to operate apple orchard and pass it on to their descendants. Simultaneously, the natural properties of perennial apple crops will further strengthen the specificity of land assets. The larger the apple planting area, the less likely it is for farmers to replant apples to other crops in the short term (FENG et al., 2018). In order to reduce the expected loss of income, farmers are more inclined to continue to engage in apple business and pass it on to their descendants. In this study, land asset specificity was characterized by orchard topography, orchard fertility, orchard irrigation area and apple planting area, and it is expected that land asset specificity will have a positive impact on farmers' intergenerational transmission willingness of apple orchard.

Geographical location

Geographical location specificity reflects the natural specificity property of agricultural land location, which is embodied in climatic conditions, regional policies and traffic conditions (LIN et al., 2016). Due to apples' natural attributes, their growth is strictly restricted by climatic and geographical conditions, such as light, rainfall, temperature and altitude, and this dependence on time and space conditions is the embodiment of geographical location specificity. Suppose apples are replanted to other crops in the apple eugenics area. In that case, they will lose the formed location advantages and face higher conversion costs (XIANG & CHEN, 2005), encouraging farmers in the apple eugenics area to maintain apple management and pass it on to their descendants. In this study, the times of apple disaster, the government support and the length of hardened roads in the village where farmers live are selected to represent the geographical location assets. These three indicators respectively reflect the suitability of climatic conditions for apple growth, the importance attached by the state or local government to the development of apple industry and the convenience of transportation in the village where farmers live (FENG et al., 2018). The fewer the number of apple disasters, the greater the government support, and the more convenient transportation in the village, the more beneficial it is to apple production and apple growers' income, thus enhancing farmers' enthusiasm for apple management intergenerational transmission willingness.

MATERIALS AND METHODS

Data sources

The data used in this study comes from the detailed household survey of apple farmers conducted by the Industrial Economics Research Office of the National Modern Apple Industry Technology System in China from July to August 2019. The sampling process is as follows: first, the sample area was determined to be the dominant area of Bohai Bay and Loess Plateau by typical sampling method; Second, according to the method of combining stratified sampling (county→township→village) and random sampling, and the principle of determining the large sample size n in statistics , this study assumed the coefficient of reliability α is 0.05, $u_\alpha = u_{0.05} = 1.96$, the coefficient of variation v is 0.2, and the sampling estimation accuracy p_c is 0.8, and determined the number of sample counties n is 8; Third, 2~5 sample townships were randomly selected from each county, 6~8 sample villages were randomly selected from each sample township, and about 20 apple growers were randomly selected from each sample village. A face-to-face questionnaire

survey was conducted among the apple production decision-makers in farmers' families. In this survey, A total of 1057 questionnaires were collected from 51 villages in 29 townships, and 51 valid village-level questionnaires and 1012 valid farmer questionnaires were obtained (Table 1) after removing some missing questionnaires, with an effective rate of 95.74%.

According to theoretical analysis, the variables selected in this study, their meanings and characteristics are shown in table 2. It should be noted that, concerning the measurement of intergenerational succession planning of agricultural management, the existing research mainly focused on the agricultural management willingness of parents, less on the agricultural management willingness of descendants, and only on the agricultural management willingness of parents or their descendants. Admittedly, the intergenerational transmission of family agricultural management involves both parents and their descendants' behavior decision. Only when the intergenerational transmission willingness of parents and that of their descendants are consistent can the intergenerational transmission of apple orchard be implemented smoothly. Therefore, in this study, the following sentences were used to characterize the intergenerational transmission willingness of apple orchard of sample farmers. "Do you want your children to inherit your apple orchard?" (hereinafter referred to as "parental willingness") (NING & NING, 2016) and "Do your children want to inherit your apple orchard?" (hereinafter referred to as "descendant willingness") (WANG & WANG, 2018). When both questions answer "yes" at the same time, it is considered that the intergenerational transmission willingness of apple orchard will be "1", otherwise, it will be "0".

Table 2 shows that only 189 households were willing to carry on apple orchards (hereinafter referred to as "willing farmers"), accounting for 18.68% of the total sample size, and the proportion of households unwilling to carry on apple orchards (hereinafter referred to as "unwilling farmers") was as high as 82.32%, which indicated that farmers' willingness to carry on the intergenerational transmission of apple orchard was generally weak, and apple business is facing the dilemma of "intergenerational transmission discontinuity". In order to preliminarily identify the relationship between asset specificity and farmers' willingness of intergenerational transmission of apple orchard, this study used SPSS 20.0 software to test the asset specificity of willing farmers and unwilling farmers with independent-samples T-test (Table 2). It is found that in terms of human capital specificity, the years of schooling and planting of apple planting decision makers of willing farmers were significantly lower than those of unwilling farmers. Regarding the specificity of physical assets, the input value of orchard machinery and equipment of willing farmers was 27.15 thousand yuan on average, which was 5.99 thousand yuan higher than that of unwilling farmers. In terms of land asset specificity, the orchard topography and orchard fertility of willing farmers were significantly higher than those of unwilling farmers. Still, the orchard irrigation area of unwilling farmers was considerably. In terms of geographical specificity, the government support and hardened road length of villages where willing farmers live were significantly higher than those of unwilling farmers, while the number of apples affected by disasters in villages where unwilling farmers live was significantly higher than that of willing farmers. The preliminarily results showed a correlation between asset specificity and farmers' intergenerational transmission willingness of apple orchard. It is necessary to test whether the correlation between them is inevitable by using econometric models.

Table 1 - Sample distribution.

Producing area	----------The Bohai Bay----------				----------The Loess Plateau----------				Total
Province	----------Shandong----------				----------Shaanxi----------				2
City	----------Yantai---------		----------Linyi---------		Yulin	Yan'an	Weinan	Xianyang	6
County	Penglai	Laizhou	Yishui	Mengyin	Mizhi	Zhidan	Pucheng	Liquan	8
Township	4	3	3	2	5	3	4	5	29
Village	6	6	6	7	6	8	6	6	51
Sample size	122	129	130	116	127	118	140	130	1012

Table 2 - Meaning of variables and its statistical characteristics.

Variable name	Variable meaning and assignment	Willing farmers (N=189)		Unwilling farmers (N=823)		Mean difference
		$Mean_w$	Std. Dev.	$Mean_u$	Std. Dev.	
Intergenerational succession willingness (ISW)	Parental willingness*descendant willingness, yes = 1; no = 0	0.19	0.39	—	—	—
----------Human capital specificity (HCS)----------						
Education	Schooling years of apple planting decision makers (years)	5.58	3.48	7.12	3.14	-1.54***
Experience	Years of apple planting decision makers engaged in apple business (years)	16.19	11.86	19.23	9.96	-3.04***
Technology	The apple production technology level of apple planting decision makers: very low = 1; low = 2; general = 3; higher = 4; very high =5	3.21	0.84	3.13	0.82	0.08
----------Physical assets specificity (PAS)----------						
Equipment	Sum of original values of orchard machinery and equipment owned by farmers in 2018 (thousand yuan)	27.15	178.88	21.16	37.01	5.99
----------Land assets specificity (LAS)----------						
Orchard topography	Plain = 1; hill = 2; mountain = 3; tableland =4	1.72	0.95	1.40	0.67	0.32***
Irrigated area	Irrigation area of apple orchard in 2018 (mu)	2.15	3.69	3.51	4.47	-1.36***
Orchard fertility	very low = 1; low = 2; general = 3; higher = 4; very high =5	3.81	0.89	3.48	0.99	0.33***
Apple area	Apple planting area in 2018 (mu)	10.61	14.38	8.93	13.99	1.68
----------Geographical location specificity (GLS)----------						
Apple disasters	Number of apple disasters in this village in 2018 (times)	0.57	0.68	0.86	0.86	-0.29***
Government support	Does the state or local government give strong support to apple production in this village? Very small = 1; smaller = 2; general = 3; larger = 4; very large =5	3.41	1.67	2.38	1.62	1.03***
Hardened roads	Total length of hardened roads in this village (km)	14.60	20.54	10.28	19.22	4.32***
----------Family characteristics----------						
Apple laborers	The number of laborers who are engaged in apple operations in 2018 (person)	2.12	0.83	1.93	0.58	0.19***
Apple income share	The proportion of apple income to total household income in 2018 (%)	55.94	29.83	52.48	30.36	3.46
Apple benefit evaluation	The evaluation of apple planting benefit by sample farmers: very low = 1; low = 2; general = 3; higher = 4; very high =5	3.05	1.05	2.83	1.08	0.22**
----------Village characteristics----------						
Non-agricultural proportion	Proportion of non-agricultural labor force in villages in 2018 (%)	37.02	17.17	41.61	17.06	-4.59***
Apple prices comparison	Compared with other villages, what is the price of apples in this village? Very low = 1; low = 2; general = 3; higher = 4; very high =5	3.52	0.95	3.30	1.12	0.22***

Note: *, ** and *** indicate that the mean values of the characteristic variables of the two types of farmers are significantly different at the statistical levels of 10%, 5% and 1%, respectively. 1 mu = 0.067 hectares. 1 yuan = 0.1555 U.S. dollars in 2018.

In addition, this study also selected the family characteristics and village characteristics of farmers as control variables, among which, the family characteristics variables included the number of apple laborers, proportion of apple income and the evaluation of apple benefits (ZHU et al., 2010; KONG et al., 2016). The village characteristics included the proportion of non-agricultural laborers in the village and the comparison of apple prices between villages (NING & NING, 2016). According to the statistical results, in terms of family characteristics, the number of apple laborers and the evaluation of apple benefits of willing farmers were significantly higher than those of unwilling farmers. At the same time, the average proportion of apple income of both types of farmers to total household income is higher than 50%, indicating that most apple growers belong to specialized farmers (HOU & HUO, 2016; LI et al., 2019). In terms of village characteristics, the evaluation of apple price by willing farmers was significantly higher than that by unwilling farmers, while the proportion of non-agricultural labor in unwilling farmers' villages was significantly higher than that of willing farmers. The above results showed that there is a correlation between the number of apple laborers in farmers' families, the evaluation of apple benefits, the proportion of non-agricultural laborers in villages and the difference of apple prices among villages and farmers' willingness to transmit apple orchard between generations.

Model setting

As the explained variable, intergenerational transmission willingness is a discrete binary variable, this study chose a binary logistic regression model to analyze the impact of asset specificity on farmers' intergenerational transmission willingness in apple orchard. The specific model was as follows:

$$P_i = F\left(\alpha + \sum_{m=1}^{11}\beta_m C_m + \sum_{n=1}^{5}\gamma_n X_n\right) = \frac{1}{1+e^{-\left(\alpha+\sum_{m=1}^{11}\beta_m C_m+\sum_{n=1}^{5}\gamma_n X_n\right)}} \quad (1)$$

The linear expression of logistic regression model was obtained by logarithmic transformation of formula (1):

$$y = Ln\left(\frac{P_i\left(y=1\middle|(C,X)\right)}{1-P_i\left(y=1\middle|(C,X)\right)}\right) = \alpha + \sum_{m=1}^{11}\beta_m C_m + \sum_{n=1}^{5}\gamma_n X_n + \varepsilon \quad (1)$$

In formulas (1) and (2), y is interpreted variables, indicating whether farmers are willing to choose intergenerational transmission of apple orchard, $P_i\left(y=1\middle|(C,X)\right)$ indicates that the conditional probability function of i th sample farmer is willing to choose the intergenerational transmission of apple orchard, and C_m is core explanatory variables, indicating asset specificity variables and including human capital specificity, physical asset specificity, land asset specificity and geographical location specificity, indicates control variables that affect farmers' willingness to intergenerational transmission of apple orchard, including family characteristics and village characteristics. α is intercept term, β_m and γ_n represent regression coefficient, ε is random error term.

RESULTS AND DISCUSSION

This study used the variance inflation factor (VIF) to test multicollinearity of all explanatory variables before regression estimation to avoid the interference of the multicollinearity problem on regression results. The results showed that the maximum value of VIF was 1.81, and the average value of VIF was 1.27, both of which were less than 10, indicating that there is no multicollinearity problem among explanatory variables. In this study, Stata 15.0 software was used for binary logistic regression, and the estimated results of the model were shown in table 3. In addition, in order to test the robustness of binary logistic regression results, this study also conducted binary probit regression, and the maximum likelihood ratios of the two models were significant at the statistical level of 1%, indicating that the goodness of fit of these two models were good. The sign and significance of the explanatory variables regression coefficients of these two models were consistent, which showed that the binary logistic regression results were robust.

The impact of human capital specificity on farmers' intergenerational transmission willingness of apple orchard

The effect of schooling years of apple planting decision-makers on farmers' willingness to intergenerational transmission of apple orchard was significant at a 1% statistical level, and its coefficient was negative, which was consistent with the T-test results but inconsistent with the theoretical hypothesis. From the marginal effect point of view, with the control of other variables, the occurrence ratio of farmers' willingness to intergenerational transmission of apple orchard will decrease by 1.16% for each additional unit of schooling years of apple planting decision-makers, which indicated that the longer the schooling years of apple planting decision-makers, the weaker the intergenerational transmission willingness. The possible reason is that with the

Table 3 - Regression results of the influence of asset specificity on farmers' intergenerational transmission willingness of apple orchard.

Variable name	----------Binary Logistic model----------			----------Binary Probit model----------		
	Coefficient	Std. Dev.	MEs	Coefficient	Std. Dev.	MEs
----------Human capital specificity (HCS)----------						
Education	-0.0916***	0.0278	-0.0116	-0.0549***	0.0156	-0.0124
Experience	0.0039	0.0107	0.0005	0.0020	0.0059	0.0004
Technology	0.1943*	0.1182	0.0246	0.1059	0.0666	0.0239
----------Physical assets specificity (PAS)----------						
Equipment	0.3178*	0.1632	0.0402	0.1638*	0.0883	0.0369
----------Land assets specificity (LAS)----------						
Orchard topography	0.3265***	0.1141	0.0413	0.1863***	0.0661	0.0420
Irrigated area	-0.0669*	0.0357	-0.0085	-0.0320*	0.0176	-0.0072
Orchard fertility	0.1724*	0.0945	0.0218	0.1050**	0.0529	0.0237
Apple area	-0.0102	0.0073	-0.0013	-0.0056	0.0039	-0.0013
----------Geographical location specificity (GLS)----------						
Apple disasters	-0.2787**	0.1259	-0.0352	-0.1506**	0.0670	-0.0340
Government support	0.1360**	0.0692	0.0172	0.0806**	0.0383	0.0182
Hardened roads	3.14e-05**	1.26e-05	3.97e-06	1.86e-05**	7.42e-06	4.20e-06
----------Family characteristics----------						
Apple laborers	0.5956***	0.1685	0.0753	0.3229***	0.0874	0.0728
Apple income share	0.0050*	0.0026	0.0006	0.0027*	0.0015	0.0006
Apple benefit evaluation	0.1658	0.1020	0.0210	0.0824	0.0561	0.0186
----------Village characteristics----------						
Non-agricultural proportion	-0.0090	0.0056	-0.0011	-0.0054*	0.0032	-0.0012
Apple prices comparison	0.0491	0.0938	0.0062	0.0259	0.0512	0.0058
Constant term	-5.4274***	0.9011		-2.9913***	0.4870	
Pseudo R^2		0.1545			0.1537	
Likelihood ratio statistics		110.9203***			119.0100***	
Logarithmic likelihood value		-404.9062			-405.2747	

Note: *, ** and *** are significant at the statistical level of 10%, 5% and 1%, respectively. MEs indicates marginal effect.

increase of their schooling years, their accumulated human capital stock and social resources increase, and the opportunities to engage in other operations will also increase, which can also provide more non-agricultural employment opportunities for their children. Human capital education is the catalyst for the non-agriculturalization of agricultural labor (NING & NING, 2016; NIE & ZHONG, 2017). Therefore, the schooling years of apple planting decision-makers had a significantly negative impact on farmers' intergenerational transmission willingness of apple planting.

At the statistical level of 10%, the technical level of decision makers in apple planting had a significantly positive impact on farmers' willingness of intergenerational transmission of apple orchard, which was consistent with the theoretical hypothesis and T-test results. From the marginal effect point of view, when other variables are controlled, the technical level of decision-makers in apple planting increased by one unit, the occurrence ratio of farmers' willingness to the intergenerational transmission of apple orchard will increase by 2.46%, which showed that apple planting decision-makers with higher level of apple production technology prefer intergenerational transmission of apple orchard. The possible reason is that the higher the apple production technology level of apple planting decision-makers, the richer their accumulated knowledge and experience of apple production, which will also become the root

of path dependence that hinders their career change and development (LUO et al., 2008; FENG et al., 2018). Therefore, apple planting decision-makers with higher level of apple production technology had greater incentive to secure next generation in farming apple orchard.

The impact of physical assets specificity on farmers' intergenerational transmission willingness of apple orchard

The impact of the original value of orchard machinery and equipment owned by farmers on their intergenerational transmission willingness of apple orchard was significant at the statistical level of 10%, and its coefficient was positive, which was consistent with the theoretical hypothesis and T-test results. From the marginal effect point of view, when other variables are controlled, the logarithm of the original value of orchard machinery and equipment increased by one unit. The occurrence ratio of farmers' willingness to intergenerational transmission of apple orchard will increase by 4.02%, indicating that the higher the value of machinery and equipment invested by farmers in orchards, the stronger their intergenerational transmission willingness of apples will be. The possible reasons are as follows: orchard machinery and equipment have strong specificity. The higher the total value of orchard machinery and equipment owned by farmers, the higher the specificity of physical assets, which will increase the difficulty and threshold for physical asset holders to withdraw, and reduce the incentive to withdraw, thus inhibiting them from adjusting the agricultural planting structure and changing the direction of production and operation (WANG et al., 2019). Therefore, the value of orchard machinery and equipment owned by farmers will strengthen the "locking effect" and intergenerational transmission willingness of apple orchard.

The impact of land asset specificity on farmers' intergenerational transmission willingness of apple orchard

Orchard topography and orchard fertility had a significantly positive impact on farmers' willingness to the intergenerational transmission of apple orchard at the statistical level of 1% and 10% respectively, which was consistent with the theoretical hypothesis and T-test results. From the marginal effect point of view, under the control of other variables, orchard topography and orchard fertility increase by one unit respectively, and farmers' willingness to intergenerational transmission of apple orchard will increase by 4.13% and 2.18% respectively. The results demonstrated that farmers with better orchard topography and orchard fertility had a strong willingness to transfer apple orchard to their descendants, which may be due to the influence of climate change. The apple eugenic areas in China move to high altitude areas, and the trend of apple production layout "moving westward and expanding northward" is obvious (ZHANG et al., 2021; ZHANG et al., 2018). The improvement of apple quality and benefit brought by the location advantage of orchards located in non-plain areas encourages farmers to manage apple orchards and transmit them from generation to generation. Soil quality is the basis of apple production, and one of the key factors affecting apple output (ZHANG & HUO, 2019). Because apple growth has great demand for soil nutrients in orchards, orchards with better fertility can provide necessary nutrients for apple growth, which is conducive to improving apple yield and quality, thereby increasing apple income and enhancing farmers' willingness to manage apple orchards and intergenerational transmission.

The influence of orchard irrigation area on farmers' intergenerational transmission willingness of apple orchard was significant at the statistical level of 10%. Its coefficient was negative, which was consistent with the T-test results but inconsistent with the theoretical hypothesis. From the marginal effect point of view, with the control of other variables, the occurrence ratio of farmers' willingness to the intergenerational transmission of apple orchard will decrease by 0.85%, indicating that the larger the orchard irrigation area, the weaker the farmers' intergenerational transmission willingness of apple orchard. The possible reasons are that in recent years, affected by the continuous dry weather, the demand for water for agricultural production is large, and most orchards are located in high-altitude areas, and water resources are seriously scarce. Farmers are obviously restricted by water resources. The larger the irrigation area of their orchards, the higher the irrigation cost (FENG et al., 2016). The actual investigation reported that the average cost of orchard irrigation for farmers was 1220.19 yuan, accounting for 12.16% of the total cost. Although better orchard irrigation conditions provide objective conditions for farmers to irrigate, higher irrigation costs will still squeeze the profit space of apples, and inhibit farmers' willingness to manage apple orchards and intergenerational transmission.

The influence of apple planting area on farmers' intergenerational transmission willingness

of apple orchard failed the significance test, and the coefficient was negative, which was inconsistent with the theoretical hypothesis and T-test results. This indicated that farmers with large apple planting area had weak intergenerational transmission willingness of apple orchard, which may be due to the dual characteristics of labor-intensive and technology-intensive, and large-scale apple management required higher apple planting technology and management level. However, the actual investigation reported that although the parents of farmers with large apple planting area tend to pass on apple orchard from generation to generation, 80.26% of the farmers' children go out for employment or engage in non-agricultural industries for a long time. Only 21.84% of the farmers' children go home to help their parents when the orchard is busy. Long-term separation from apple production increases the technical and management threshold for farmers' children to inherit large-scale apple orchard, resulting in only 19.17% of farmers' children willing to inherit their parents' orchards.

The influence of geographical location specificity on farmers' intergenerational transmission willingness of apple orchard

The impact of the number of apple disasters in the village on farmers' intergenerational transmission willingness of apple orchard was significant at the statistical level of 5%. Its coefficient was negative, which was consistent with the theoretical hypothesis and T-test results. From the marginal effect point of view, with the control of other variables, when the number of apple disasters in the village increases by one unit, the occurrence ratio of farmers' willingness to intergenerational transmission of apple management will decrease by 3.52%. This indicated that the more apple disasters in the village, the weaker the farmers' intergenerational transmission willingness of apple orchard. The possible reasons are that the more apples are affected, the greater the apple production costs, income loss and management risks borne by farmers in villages, which will inhibit farmers' willingness to transmit apple orchards from generation to generation (ZHANG & HUO, 2021; KONG et al., 2016).

Both government support and village hardened road length had a significantly positive impact on farmers' intergenerational transmission willingness of apple orchard at the statistical level of 5%, which was consistent with the theoretical hypothesis and T-test results, So, farmers in villages with strong government support and long village hardened road have strong intergenerational transmission willingness of apple orchard, possibly because the government's support for village apple production will guide and encourage farmers' decision-making behavior of apple management. The stronger the government support, the more policy dividends, such as apple subsidies, technical support and information services enjoyed by villages, which was conducive to mobilizing farmers' enthusiasm for apple business and intergenerational succession planning (LIU et al., 2012). The greater distance of hardened roads in the village, the more complete its transportation facilities may be, and the more convenient it is for farmers to obtain information on apple production and market, purchase agricultural materials and sell products (FENG et al., 2018). This is conducive to reducing apple production costs, improving product value, expanding the profit space of apple operation, and thus enhancing farmers' intergenerational transmission willingness of apple orchard.

The influence of control variables on farmers' intergenerational transmission willingness of apple orchard

The influence of the number of apple laborers and the ratio of apple income on farmers' intergenerational transmission willingness of apple orchard was significant at the statistical level of 1% and 10%, respectively. Their coefficients were both positive, indicating that the larger the number of apple laborers and the higher the proportion of apple income in farmers' families, the stronger their intergenerational transmission willingness of apple orchard. The possible reasons are that farmers with a large number of apple laborers and a high proportion of apple income have a higher degree of dependence on apple business, and at the same time, their apple production is highly specialized, and their household livelihood mainly depends on apples.

CONCLUSION

Based on the detailed household survey of family-owned apple orchards from Shandong and Shaanxi province in China, this study examined the impact of asset specificity on farmers' willingness to succeed apple orchard. The results showed that: first, only 18.68% of the sample farmers were willing to transmit apple orchard from generation to generation, and farmers' intergenerational transmission willingness of apple orchard was generally weak. Second, the specificity of human capital, physical assets, land assets and geographical location significantly impacted farmers' intergenerational

succession planning of apple orchard. Specifically, the higher the level of apple production technology, the greater the value of orchard facilities and machinery, the better the orchard terrain and fertility, the more the government support for apple production in villages, and the greater distance of hardened roads in villages, the stronger the intergenerational transmission willingness of farmers' apple orchard. The greater period of schooling in apple planting decision makers in farmers' families, the larger the irrigated area of orchards and the more affected by apple disasters in villages, the weaker farmers' willingness to succeed apple orchard to next generation. The above findings made up for the deficiency that the existing research paid less attention to asset specificity when examining intergenerational transmission of agricultural management, and expanded the understanding of intergenerational transmission behavior of perennial crop.

The policy implications of this study are as follows:

First, we should strengthen technical training to effectively improve farmers' human capital. Under the realistic background that the education level of apple labor force is mainly junior high school and below, attention should be paid to training apple production technology to improve farmers' apple management ability.

Second, we should strengthen infrastructure construction and focus on improving apple production conditions. On the one hand, it is necessary to strengthen the infrastructure construction of village roads, agricultural water conservancy, disaster prevention and disaster relief equipment in apple producing areas to reduce the operating costs and risks of diseases to apples. On the other hand, we should increase policy support to apple growers, and mobilize and enhance their enthusiasm for apple business and their willingness to transmit from generation to generation.

Third, we should support professional farmers' management and pay attention to developing moderate scale management. It is necessary to encourage and support the cultivation and development of professional farmers and develop moderate scale operation by promoting the transfer of land to professional farmers with a good endowment of apple production factors, so as to enhance the efficiency and benefit of apple production.

Because the data used in this study are cross-sectional data, most of the respondents were the head of the household and the main apple operator in the household, and most of the next generation worked outside the home, it is difficult to get their opinions during the survey period. This study only used the current owner's perspective to present the willingness of the next generation to take over the apple farm, and suffers from a lack of direct investigation on the willingness of the next generation. Thus, providing some insights concerning the willingness of the next generation and its factors may evolve in the future.

ACKNOWLEDGEMENTS

We are thankful for the financial support of the China Agriculture Research System (CARS-28) and the National Natural Science Foundation of China (71573211).

DECLARATION OF CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHORS' CONTRIBUTIONS

Conceptualization: Qiangqiang Zhang, Xixi Wu and Xuexi Huo. Data acquisition: Qiangqiang Zhang, Xixi Wu and Yue Wang. Design of methodology and data analysis: Qiangqiang Zhang and Xixi Wu. Writing—original draft preparation: Qiangqiang Zhang, Xixi Wu and Nazir Muhammad Abdullahi. Writing—review and editing: Qiangqiang Zhang, Xixi Wu, Nazir Muhammad Abdullahi, Yue Wang and Xuexi Huo. Supervision and project administration: Xuexi Huo. All authors critically revised the manuscript and approved of the final version.

REFERENCES

CHEN, J.; LUO, M. Asset specificity, uncertainty and rice planting mode selection. **Journal of South China Agricultural University (Social Science Edition)**, v.16, n.5, p.86-97, 2017. Available from: <https://kns.cnki.net/kcms/detail/detail.aspx?FileName=HNNA201705008&DbName=CJFQ2017>. Accessed: Mar. 18, 2020. ISSN:1672-0202.

FENG, X.; HUO, X. Total factor productivity of apple industry in China considering non-point source pollution and its spatial concentration analysis. **Transactions of the Chinese Society of Agricultural Engineering (Transactions of the CSAE)**, v.31, n.18, p.204-211, 2015. Available from: <http://d.wanfangdata.com.cn/periodical/nygcxb201518029>. Accessed: Apr. 19, 2018. doi: 10.11975/j.issn.1002-6819.2015.18.029.

FENG, X. et al. Empirical study on the adaptability behavior of specialized farmers' climate change under water resources constraints: A case study of 663 apple growers in Shaanxi Province. **Journal of Agrotechnical Economics**, n.9, p.18-27, 2016. Available from: <https://kns.cnki.net/kcms/detail/detail.aspx?FileName=NYJS201609002&DbName=CJFQ2016>. Accessed: Mar. 19, 2018. doi: 10.13246/j.cnki.jae.2016.09.002.

FENG, X. et al. The impacts of asset specificity on specialized farmers' adaptation to climate change: Evidence from apple farmers in Shaanxi Province. **China Rural Survey**, n.4, p.74-85, 2018. Available from: <https://kns.cnki.net/kcms/detail/detail.aspx?FileName=ZNCG201804006&DbName=CJFQ2018>. Accessed: Nov. 19, 2018. ISSN:1006-4583.

HOU, J. et al. Empirical analysis of land lease market economic effect: The micro evidence from apple growers. **Journal of Nanjing Agricultural University (Social Sciences Edition)**, v.16, n.2, p.93-104, 2016. Available from: <https://kns.cnki.net/kcms/detail/detail.aspx?FileName=NJNS201602011&DbName=CJFQ2016>. Accessed: Nov. 19, 2017. ISSN: 1671-7465.

KONG, D. et al. Analysis on the willingness and influence factors of herdsmen's grassland animal husbandry management intergenerational transmission: Based on the survey of 34 Gacha in Inner Mongolia. **China Rural Survey**, n.1, p.75-85, 2016. Available from: <https://kns.cnki.net/kcms/detail/detail.aspx?FileName=ZNCG201601008&DbName=CJFQ2016>. Accessed: Nov. 19, 2017. ISSN: 1006-4583.

LEONARD, B. et al. Policy drivers of farm succession and inheritance. **Land Use Policy**, v.61, p.147-159, 2017. Available from: <https://doi.org/10.1016/j.landusepol.2016.09.006>. Accessed: Nov. 19, 2017. doi: 10.1016/j.landusepol.2016.09.006.

LI, K. The effects of farmland used specificity and the uncertainty of transactions on the transaction costs of farmland transfer. **Management World**, 3, p.92-98, 2009. Available from: <https://kns.cnki.net/kcms/detail/detail.aspx?FileName=GLSJ200903012&DbName=CJFQ2009>. Accessed: Nov. 19, 2010. doi: 10.19744/j.cnki.11-1235/f.2009.03.011.

LI, M. et al. Analysis of farmers' quality and grain willingness in major grain producing areas: Based on the survey of 457 farmers in 6 major grain producing provinces. **Chinese Rural Economy**, n.6, p.27-37, 2013. Available from: <https://kns.cnki.net/kcms/detail/detail.aspx?FileName=ZNJJ201306005&DbName=CJFQ2013>. Accessed: Nov. 19, 2014. ISSN: 1002-8870.

Li, X. et al. Effects of farmland registration and confirmation on the choice of farmers' livelihood strategy: Evidence from apple growers. **Resources Science**, v.41, n.10, p.1923-1934, 2019. Available from: <https://kns8.cnki.net/kcms/detail/detail.aspx?FileName=ZRZY201910014&DbName=CJFQ2019>. Accessed: Nov. 19, 2020. ISSN: 1007-7588.

LIN, W. et al. The effect of asset specificity on farmland transfer after land registration and certification. **Journal of South China Agricultural University (Social Science Edition)**, v.15, n.6, p.1-9, 2016. Available from: <https://kns8.cnki.net/kcms/detail/detail.aspx?FileName=HNNA201606001&DbName=CJFQ2016>. Accessed: Nov. 19, 2017. ISSN:1672-0202.

LIU, Z. et al. Analysis of rice cropping decision-making in a double-cropping rice area of Southern China. **Resources Science**, v.34, n.12, p.2234-2241, 2012. Available from: <https://kns8.cnki.net/kcms/detail/detail.aspx?FileName=ZRZY201212005&DbName=CJFQ2012>. Accessed: Jan. 19, 2013. ISSN: 1007-7588.

LUO, B. et al. Asset specificity, specialized production and the market risk of the peasant-household. **Issues in Agricultural Economy**, n.7, p.10-15, 2008. Available from: <https://kns.cnki.net/kcms/detail/detail.aspx?FileName=NJWT200807001&DbName=CJFQ2008>. Accessed: Jan. 19, 2010. ISSN: 1000-6389.

MA, W. et al. Agricultural cooperative membership and technical efficiency of apple farmers in China: An analysis accounting for selectivity bias. **Food Policy**, v.81, p.122-132, 2018. Available from: <https://doi.org/10.1016/j.foodpol.2018.10.009>, Accessed: Jul. 30, 2019. doi: 10.1016/j.foodpol.2018.10.009.

NIE, J. et al. The marketnization of labor force, individual life: Cycle and the willingness of farmers in land management. **Journal of Nanjing Agricultural University (Social Sciences Edition)**, v.17, n.1, p.71-79, 2017. Available from: <https://kns.cnki.net/kcms/detail/detail.aspx?FileName=NJNS201701009&DbName=CJFQ2017>. Accessed: Jan. 19, 2018. ISSN:1671-7465.

NING, Z. et al. Effects of location and non- agricultural employment on Chinese family farm succession: On left-behind farmers in Shaanxi Province. **Finance and Trade Research**, v.27, n.2, p.75-84, 2016. Available from: <https://kns.cnki.net/kcms/detail/detail.aspx?FileName=CMYJ201602011&DbName=CJFQ2016>. Accessed: Jan. 19, 2017. doi: 10.19337/j.cnki.34-1093/f.2016.02.009.

QIAO, Z. et al. 2017. Impact of agricultural labor aging on farmland use efficiency. **Journal of South China Agricultural University (Social Science Edition)**, v.16, n.5, p.61-73, Available from: <https://kns.cnki.net/kcms/detail/detail.aspx?FileName=HNNA201705006&DbName=CJFQ2017>. Accessed: Jan. 19, 2018. ISSN: 1672-0202.

SUESS-REYES, J. et al. The future of family farming: A literature review on innovative, sustainable and succession-oriented strategies. **Journal of Rural Studies**, 47, p.117-140, 2016. Available from: <https://doi.org/10.1016/j.jrurstud.2016.07.008>. Accessed: Jan. 29, 2017. doi: 10.1016/j.jrurstud.2016.07.008.

USDA Foreign Agricultural Service. Fresh apples, grapes, and pears: World markets and trade. **Washington, D.C.** 2021. Available from: <https://www.fas.usda.gov/data/fresh-apples-grapes-and-pears-world-markets-and-trade>. Accessed: Aug. 24, 2021.

WANG, J. et al. Effect mechanism of rural population aging on agricultural production. **Journal of South China Agricultural University (Social Science Edition)**, v.19, n.2, p.60-73, 2020. Available from: <https://kns.cnki.net/kcms/detail/detail.aspx?FileName=HNNA202002007&DbName=CJFQ2020>. Accessed: Nov. 19, 2020. ISSN: 1672-0202.

WANG, N. et al. Towards sustainable intensification of apple production in China — Yield gaps and nutrient use efficiency in apple farming systems. **Journal of Integrative Agriculture**, v.15, n.4, p. 716-725, 2016. Available from: <https://doi.org/10.1016/S2095-3119(15)61099-1>, Accessed: Jul. 30, 2021. doi: 10.1016/S2095-3119(15)61099-1.

WANG, S. et al. Impact factors on farmers' willingness and time point of intergenerational succession in agricultural management: Based on evidence of threshold regression model. **Agricultural Economics and Management**, n.4, p.48-58, 2018. Available from: <https://kns.cnki.net/kcms/detail/detail.aspx?FileName=NYJG201804006&DbName=CJFQ2018>. Accessed: Jan. 19, 2019. ISSN: 1674-9189.

WANG, Y. et al. Asset specificity, risk aversion and agricultural machinery households' production and management. **Finance and Trade Research**, v.30, n.11, p.39-47, 2019. Available from: <https://kns.cnki.net/kcms/detail/detail.aspx?FileName=CMYJ201911004&DbName=CJFQ2019>. Accessed: Jan. 19, 2020. doi: 10.19337/j.cnki.34-1093/f.2019.11.004.

WILLIAMSON, O. E. The Mechanism of Governance. **Oxford University Press: New York, USA**. 1996. Available from: <https://global.oup.com/academic/product/the-mechanisms-of-

governance-9780195078244?lang=en&cc=cn>. Accessed: Jan. 19, 2012. ISBN:9780195078244.

XIANG, G. et al. Asset specificity and risk aversion in adjustment of agricultural production structure. **Issues in Agricultural Economy**, 3, p.49-52, 2005. Available from: <https://kns.cnki.net/kcms/detail/detail.aspx?FileName=NJWT200503009&DbName=CJFQ2005>. Accessed: Jan. 19, 2010. ISSN: 1000-6389.

ZHANG, C. et al. Analysis on the layout of China's apple production transition. **Economic Geography**, v.38, n.8, p.141-151, 2018. Available from: <https://kns.cnki.net/kcms/detail/detail.aspx?FileName=JJDL201808018&DbName=DKFX2018>. Accessed: Jan. 19, 2019. doi: 10.15957/j.cnki.jjdl.2018.08.018.

ZHANG, L. et al. Land scale and farmland quality conservation behavior of farmers: An analysis based on 771 apple growers. **Agricultural Economics and Management**, n.6, p.48-61, 2019. Available from: <https://kns.cnki.net/kcms/detail/detail.aspx?FileName=NYJG201906006&DbName=CJFQ2019>. Accessed: Jan. 19, 2020. ISSN:1674-9189.

ZHANG, Q. et al. The Evolutionary Characteristics of Apple Production Layout in China from 1978 to 2016. **Ciência Rural**, v.51, n.6, p.1-13, 2021. Available from: <https://doi.org/10.1590/0103-8478cr20200688>, Accessed: Aug. 19, 2021. doi: 10.1590/0103-8478cr20200688.

ZHANG, Q.; HUO, X. Intergenerational transmission of willingness of apple management for apple growers in Shandong and Shaanxi. **Journal of Arid Land Resources and Environment**, v.35, n.3, p.52-57, 2021. Available from: <https://t.cnki.net/kcms/ detail?v=3uoqIhG8C46NmWw7YpEsKMypi3qVj28LEUDxQXHYyS3fbyEOrIfBzA aHzJa2T6uOFg7um7_kaZUpr17_qWtuyJa1_ o_WoJHI&uniplatform=NZKPT >. Accessed: Feb. 19, 2021. doi: 10.13448/j.cnki.jalre.2021.068.

ZHOU, L. et al. Research on the effect of China's new rural pension scheme on the intergenerational succession of agricultural management. **Journal of Guangdong University of Finance & Economics**, v.32, n.5, p.58-69, 2017. Available from: <https://kns.cnki.net/kcms/detail/detail.aspx?FileName=SONG201705006&DbName=CJFQ2017>. Accessed: Jan. 19, 2018. SSN: 1008-2506.

ZHU, H. et al. Empirical analysis of farmers' intergenerational transmission willingness of rice management and its influencing factors: Based on survey data of 619 large grain farmers in Jiangxi. **Chinese Rural Economy**, n.2, p.22-32, 2010. Available from: <https://kns.cnki.net/kcms/detail/detail.aspx?FileName=ZNJJ201002004&DbName=CJFQ2010>. Accessed: Jan. 19, 2011. ISSN: 1002-8870.