

Article

An Assessment of Poverty Alleviation Measures and Sustainable Livelihood Capability of Farm Households in Rural China: A Sustainable Livelihood Approach

Fang Su ¹, Nini Song ¹, Nannan Ma ¹, Altynbek Sultanaliyev ¹, Jing Ma ², Bing Xue ³ and Shah Fahad ^{4,*}

¹ School of Economics and Management, Shaanxi University of Science and Technology, Xi'an 710021, China; sufang@sust.edu.cn (F.S.); bs1907004@sust.edu.cn (N.S.); 1807040@sust.edu.cn (N.M.); altynbek@sust.edu.cn (A.S.)

² College of Resources and Environmental Sciences, Gansu Agricultural University, Lanzhou 730030, China; majing@gsau.edu.cn

³ Key Lab for Environmental Computation and Sustainability of Liaoning Province, Institute of Applied Ecology, Chinese Academy of Sciences, Shenyang 110016, China; xuebing@iae.ac.cn

⁴ School of Economics and Management, Leshan Normal University, Leshan 614000, China

* Correspondence: shah.fahad@mail.xjtu.edu.cn; Tel.: +86-18591927913

Abstract: This paper aims to identify effective mechanisms for government poverty alleviation measures based on the livelihood sustainability of farm households in Southern Shaanxi province, China. The paper utilizes data from 414 farm households, collected through field observations and in-depth interviews in 24 rural communes in Qinba Mountain Area of Shaanxi province, China. Using theoretical research methods and employing the sustainable livelihood approach (SLA) framework, this paper analyzes poverty alleviation measures as well as the impact of varied capital availability on sustainable livelihood. The study shows that developing local industries and governmental financial support improve the sustainable livelihood of farmers and eradicate absolute poverty. The findings of this study further indicate that there is a positive correlation between poverty alleviation measures and natural and social capital for sustainable livelihood. The paper provides empirical and quantitative evidence on alleviation of poverty, and the findings will help improve the sustainability of livelihood capability of farming households. This study suggests impactful approaches to stabilizing mechanisms for poverty alleviation in rural areas over the longer term.

Keywords: poverty alleviation measures; sustainable livelihood capability; interaction effect; sustainable rural development; Qinba Mountains



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1. Introduction

The proportion of people living in extreme poverty globally fell from 36% in 1990 to 8.4% in 2019 [1]. However, public crises, such as climate change and the COVID-19 pandemic, threaten to undermine efforts to eradicate extreme poverty [2]. In 2020, and on schedule, China accomplished its poverty alleviation target for the new era, as regards eradication of absolute poverty and overall regional poverty [3,4]. However, for developing countries and regions, poverty eradication is still an intermediate goal in rural development and does not imply the end of rural poverty concerns [5]. Hence, the issue of relative poverty has been incorporated into the national poverty alleviation strategy [6].

Poverty is usually defined in two ways: (1) a continuous shortage of income or material resources; and (2) a chronic insufficiency of human capability. According to the fundamental exploration by Sen and Robeyns [7,8], the root of poverty is deprivation of capability. Capability includes not only income, but also education, health, and quality of life, among many others. In other words, poverty refers to both lack of income and lack of sustainable livelihood capability, resulting in a weakened quality of life. It is particularly a

non-material insufficiency, which is more in line with the definition of poverty underlying the current alleviation and eradication policies [9].

The existing research on sustainable livelihoods mainly refers to the spatial differentiation of livelihoods [10], the interaction between livelihood activities and ecological environment [11,12], the impact of climate change on livelihoods [13,14], the relationship between “land use evolution” and livelihood output [15,16], the impact of ecological compensation on farmers’ livelihood [17,18], and the impact of rural tourism on farmers’ livelihoods [19], as well as livelihood vulnerability assessment [20].

The Sustainable Livelihood Approach (SLA), based on the concept of “capability deficits”, is being widely used in poverty reduction and development projects around the world [21]. This integrated analysis framework offers constructive tools for finding the causes of the fragility of farmers’ livelihoods and providing multiple solutions. At present, research within the Sustainable Livelihood Approach mainly focuses on the following aspects: quantitative analysis of sustainable livelihood capability [22,23], investigation of the impact of external interventions on sustainable livelihood capability [24–26], and the impact of livelihood capital on farming capability [27]. Nevertheless, there have been few studies of the systemic relationship between poverty alleviation measures, livelihood capital, and sustainable livelihood capability. Current studies place less emphasis on the direct and indirect impacts of poverty alleviation measures on farmers’ sustainable livelihood capability. In the real world, such content offers an important basis for regional poverty alleviation policies.

This study takes survey data on farmers from Qinba Mountain Area in southern Shaanxi Province, China (as shown in Figure 1), and attempts to uncover the impact of nine poverty alleviation measures (as shown in Table 1) currently being implemented in China [28]. The study also proposes a reference for implementation of global poverty alleviation measures and improvement of farmers’ sustainable livelihood capability.



Figure 1. Map of the Qinba Mountain Area in South-Shaanxi, China.

Table 1. Description of poverty alleviation measures.

Poverty Alleviation Measures	Concept	Main Manifestations
Poverty alleviation by relocation	Poor people living in areas lacking living conditions relocate to other areas.	Poverty alleviation relocation project to prevent disasters, such as mudslides.
Poverty alleviation by developing industries	Providing jobs promoting human capital and actively participating in all aspects of the industry chain.	Eco-aquaculture, green planting, and sightseeing agriculture.
Poverty alleviation through e-commerce	Using the idea of electronic commerce to promote the development of local industry.	Poverty alleviation through business startups, employment of local farmers.
Poverty relief through tourism	Develop abundant local tourism resources and set up tourism economic entities.	Constructing core scenic spots and developing tourism products.
Poverty alleviation by developing education	On the premise of guaranteeing nine-year compulsory education, local courses and school-based courses should be offered according to actual needs.	Free and subsidized higher vocational education and non-formal education for skills.
Poverty alleviation by ecological protection	Through mechanisms of ecological protection, restoration and compensation, poverty-stricken people can fight poverty by joining in environmental protection projects.	Return farmlands to forests and grasslands.
Financial poverty alleviation	Providing technology, capital, financial products, financial services and other forms of economic support.	Build pioneer area for financial poverty alleviation, increase credit funds, expand financial services, and develop targeted credit products.
Social assistance in poverty alleviation	Implementing relevant counterpart assistance and motivating leading enterprises into industrial cooperation.	Collaboration and paired assistance between urban and rural.
Poverty alleviation through sci-techniques	Applying advanced and applicable science and technology to improve farmers' scientific and cultural awareness, resource development quality and productivity.	Focus on supporting walnut, traditional Chinese medicine, tea, thematic farming, organic rice, and other industries.

2. Theoretical Analysis

The Sustainable Livelihood Analysis (SLA) framework developed by the UK Department for International Development (DFID) in 2003 is the most framework most widely recognized by scholars [29]. Its two-dimensional diagram represents core variables such as vulnerability context, livelihood capital, structural and process changes, and livelihood strategies and goals, as well as typical relationships between them. The SLA framework addresses five kinds of overall livelihood capital: (1) human capital, (2) physical capital, (3) natural capital, (4) financial capital and (5) social capital. It mainly aims at analyzing how farmers use their livelihood capital and best strategies to increase their livelihood level in a risky environment affected by institutional policies, agricultural markets and natural factors. It mainly reflects the interaction between farmers' livelihood structures, processes and objectives. DFID proposed the framework for sustainable livelihood analysis to generate a dynamic and comprehensive understanding of farmers' concerns and help people find appropriate ways to improve their livelihood. The framework reveals the relationships among the factors affecting farmers' livelihoods. It can also be used in identifying the main constraints affecting farmers' sustainable livelihood capability and their interrelation, which are of great significance in reducing poverty [30].

The purpose of SLA is to identify the most urgent constraints and the most promising development opportunities faced by farmers. This provides a new perspective for improving the quality of life and livelihood sustainability of farmers [31]. In addition, the SLA might include the following three aspects.

- (1) Diversification of livelihood capital. This mainly refers to the efforts leading to proliferation and preservation of the overall livelihood capital. It provides the method and assurances for sustainability of livelihoods.

- (2) Minimizing vulnerability to environmental risks. This mainly involves minimizing the risk of negative impacts on farmers' livelihood sustainability, such as environmental vulnerability risk, policy change risk and economic fluctuation risk [32].
- (3) Maximizing livelihood output. Under certain environmental conditions, farmers use all kinds of livelihood capital to maximize their livelihood output by adopting and optimizing livelihood strategies. The livelihood sustainability of farmers can be reflected through the levels and range of their overall capital.

Our study focused on three aspects: (1) the value-added phenomena of livelihood capital, (2) formulation of livelihood policies for farmers and (3) measurement of sustainable livelihood capability. Through theoretical deduction and empirical research, the study explored the relationship of the three factors, especially the influence of the first two aspects on the third. In the following model, the framework of sustainable livelihoods is designed in light of existing research [33,34]. Its general form can be expressed as follows:

$$SL = I \times f(H, F, S, P, N) - I \times g(R, V) \quad (1)$$

In Equation (1), SL , I , H , F , S , P , N , R , and V represent sustainable livelihood capability, institutional factors, human capital, financial capital, social capital, physical capital, natural capital, risk factors, and fragile environment, respectively. The $f(H, F, S, P, N)$ represents the livelihood capital function; the $g(R, V)$ represents the fragile environment and risk function, which facilitates analysis. The influence of a fragile environment and risk is omitted in the later analysis.

The sustainability of livelihoods for farmers is represented by $SL > 0$. The combination and accumulation of the five kinds of livelihood capital can create a sustainable livelihood capability. Increases in environmental vulnerability and risk factors will reduce the sustainability of livelihood for farmers; institutional factors will additionally provide an exogenous impact on sustainable livelihood capability. For the purposes of the present study, the principal model shown in Equation (1) can be simplified to Equation (2):

$$SL = I \times f(H, F, S, P, N) \quad (2)$$

The principal model can be used as part of a poverty alleviation policy. There are nine existing poverty alleviation measures in Qinba Mountain Area in southern Shaanxi [35]. They cover poverty alleviation by relocation, poverty alleviation by developing industries, poverty alleviation by developing education, poverty alleviation by ecological protection, social assistance in poverty alleviation, financial poverty alleviation, poverty alleviation through e-commerce, poverty alleviation through sci-techniques and poverty relief through tourism. The poverty alleviation measures can directly affect the sustainable livelihood of farmers as well as indirectly improve the human, financial, social, physical and natural capital. It is further assumed that the function SL satisfies the following properties: for all $H > 0$, $F > 0$, $S > 0$, $P > 0$, $N > 0$ and $I > 0$, the improvement of each dimension level will bring about positive development of function SL , although this positive effect decreases marginally. Equation (3) can be obtained by transforming Equation (2):

$$g_{SL} = \delta_H g_H + \delta_F g_F + \delta_S g_S + \delta_P g_P + \delta_N g_N + \delta_I g_I \quad (3)$$

where g_H , g_F , g_S , g_P , g_N , g_I indicate the growth rate of sustainable livelihood capability, livelihood capital in all dimensions and poverty alleviation measures, respectively, while δ_H , δ_F , δ_S , δ_P , δ_N express the output elasticity in different dimensions of livelihood capital, as well as various poverty alleviation measures, respectively.

$$\delta_I = 1 + \delta_H \tilde{\zeta}_H^I + \delta_F \tilde{\zeta}_F^I + \delta_S \tilde{\zeta}_S^I + \delta_P \tilde{\zeta}_P^I + \delta_N \tilde{\zeta}_N^I \quad (4)$$

In Equation (4), ζ_H^I , ζ_F^I , ζ_S^I , ζ_P^I and ζ_N^I indicate the output elasticity of human, financial, social, physical and natural capital, respectively, and a set of poverty alleviation measures. Finally, the combination of Equations (3) and (4) gives Equation(5):

$$g_{SL} = \delta_H(g_H + \zeta_H^I g_I) + \delta_F(g_F + \zeta_F^I g_I) + \delta_S(g_S + \zeta_S^I g_I) + \delta_P(g_P + \zeta_P^I g_I) + \delta_N(g_N + \zeta_N^I g_I) + g_I \quad (5)$$

Equation (5) shows the impacts of human, financial, social, physical and natural capital on sustainable livelihood capability. In addition, the set of poverty alleviation measures indirectly affects sustainable livelihood capability through impacting human, financial, social, physical and natural capital. The degree of the impacts can be found as follows: $\delta_H \zeta_H^I g_I$, $\delta_F \zeta_F^I g_I$, $\delta_S \zeta_S^I g_I$, $\delta_P \zeta_P^I g_I$, $\delta_N \zeta_N^I g_I$.

The theoretical model generates four hypotheses as follows:

Hypothesis 1 (H1). *The overall livelihood capital positively affects sustainable livelihood capability.*

Human capital helps farmers acquire knowledge and skills through investments in education, practical experience, training, health care and migration to bring about the improvement of capability. The amount of financial capital directly impacts the farmer's future income, and income is a direct indicator of sustainable livelihood capability. Physical capital includes personal housing and transportation, tools, etc., and can affect a farmer's sustainable livelihood capability. Social capital is implicit but it can improve social efficiency and integration through cooperation with other people.

This kind of connection between individuals, organizations and others can promote the improvement of individual ability, income and social status. It can thus improve the sustainable livelihood capability of farmers. The more services provided by natural capital, the higher the output and income of farmers, which is conducive to the improvement of sustainable livelihoods.

Hypothesis 2 (H2). *Different types of livelihood capital have different impacts on sustainable livelihood capability.*

Based on Hypothesis 1, all kinds of livelihood capital will promote the livelihood capability of farmers. However, due to the differences in livelihood capital owned by farmers, the degree of its impact on sustainable livelihood capability is also different. Therefore, based on Hypothesis 1, Hypothesis 2 is put forward—that the promotion effect of different kinds of livelihood capital on farmers' sustainable livelihood capability will be different.

Hypothesis 3 (H3). *A set of poverty alleviation measures positively affects farmers' sustainable livelihood capability.*

The implementation of poverty alleviation measures will promote the improvement of farmers' sustainable livelihood capability in many ways, such as promoting employment and raising income level. The set of poverty alleviation measures can directly improve the sustainable livelihood capability of farmers by affecting their standard of living, welfare level, richness of entertainment opportunities, income level, employment opportunities, ecological protection awareness, energy use and rural attachment.

Hypothesis 4 (H4). *A set of poverty alleviation measures indirectly affects farmers' sustainable livelihood capability by affecting livelihood capital.*

The poverty alleviation measures can also indirectly affect farmers' sustainable livelihood capability by affecting human, physical, financial, social and natural capital. For example, the government may directly grant economic subsidies to increase the stock of financial capital of farmers. Likewise, the government may provide technical guidance to

farmers so that they can increase their natural capital stock while protecting the ecological environment.

Based on the above research hypotheses, a diagram of the impact of poverty alleviation measures applied to the sustainable livelihood capability of farmers was constructed as shown in Figure 2.

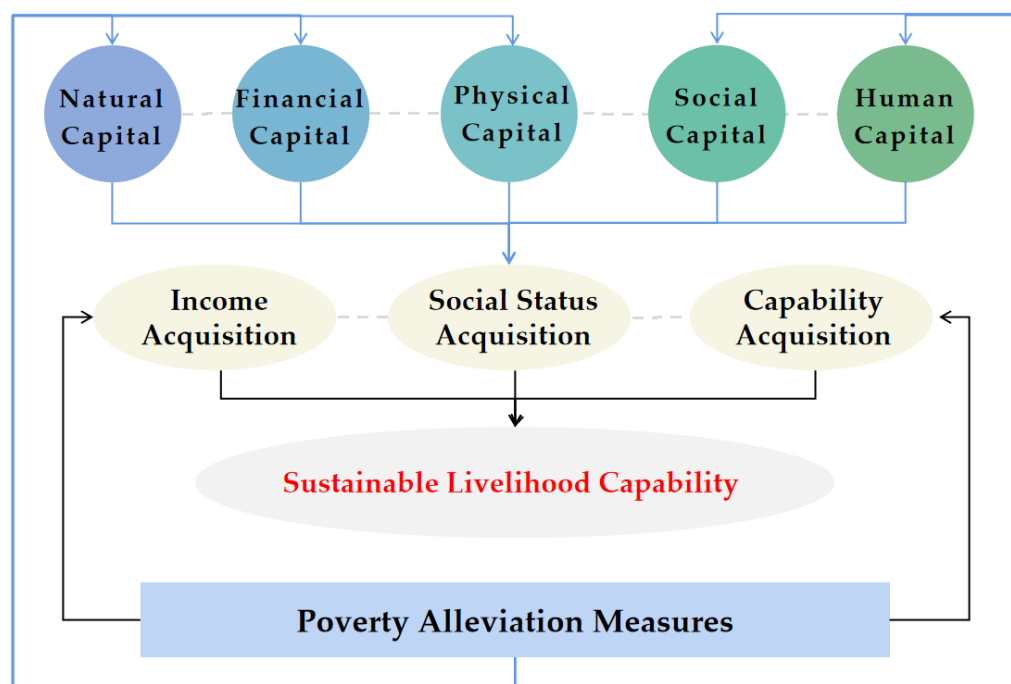


Figure 2. Relationships between poverty alleviation measures and sustainable livelihood capability.

3. Materials and Methods

3.1. Data Sources

Qinba Mountains is a term referring to the Qinling and Bashan areas in southwest China, which cover Shaanxi, Gansu, Sichuan, Chongqing, Hubei and Henan provinces. Qinba Mountain Area in southern Shaanxi includes the three cities of Ankang, Hanzhong and Shangluo. The land area is 70,200 square kilometers, accounting for 34 percent of the total Shaanxi province territory. At the end of 2018, the total population in Qinba Mountain Area in southern Shaanxi was about 9.35 million or 24.2 percent of the total population of Shaanxi province. This area is one of the main battlefields for poverty alleviation in rural China, as proposed in the outline of China's rural poverty alleviation and development program (2011–2020) [36]. In addition, it is an important water source region for China's South-to-North Water Diversion Project and an ecological function-restricted development zone. Therefore, the research on the sustainable livelihoods of farmers in the Qinba Mountainous area in southern Shaanxi is of great significance for the stabilization of poverty alleviation in China.

Statistical data on social and economic development for the study area were collected and sorted. Participatory rural assessment tools (PRA) such as social surveys and small symposiums were then designed to obtain the necessary information. The PRA method focuses on natural resource utilization, ecological environment and socio-economic conditions of the sample area, and uses informal interviews with farmers to gain a comprehensive understanding of actual rural conditions. In order to make the data more realistic and credible, the PRA was applied in the sequence "Preliminary questionnaire design—Pre-survey—Questionnaire revision". This process was repeated several times until the questionnaire was presented in a way that was understood and accepted by the farmers and the pre-survey achieved the desired results, before entering the field survey stage.

The main contents of the final questionnaire were as follows: (1) Survey on farmers' livelihood capital, including human capital, natural capital, financial capital, physical capital and social capital. (2) Survey on farmers' livelihood risk, including health risk, environmental risk, financial risk, social risk and information risk. (3) Survey on farmers' poverty alleviation needs, especially the alleviation of needs that farmers' most expect to occur. (4) Survey on farmers' livelihood strategies, mainly including animal husbandry/aquaculture, planting crops, household sidelines, part-time work, individual transportation, peasant business and other activities. (5) Survey on farmers' sustainable livelihood capability, mainly including the farmers' standard of living, welfare level, entertainment opportunities, income level, employment opportunities, ecological protection awareness, energy utilization and rural attachment.

Regarding the selection of investigators, before the survey began in April 2019, a group of 30 surveyors (including colleagues and graduate students) with statistical knowledge and involvement in previous studies were recruited from these areas. After a month of screening, 25 surveyors and 5 reserve surveyors were identified. To ensure the quality of the survey and improve the response rate of the questionnaire, the investigators were trained for 15 days in May 2019. In order to refine the draft questionnaires and finally determine the sample size, a pilot survey was conducted involving 50 households. Ten (10) surveyors, selected randomly from the investigative team, also conducted group discussions with village heads, village party secretaries and village accountants before the formal survey. These discussions were intended to obtain more background information and reveal deeper views held by managers. In August 2019, the poverty-stricken households in Qinba Mountain Area in southern Shaanxi Province were formally investigated. All 30 surveyors were involved in the investigation: 25 formal investigators were divided into 5 groups to participate in the whole process of the investigation, and 5 backup investigators replaced the formal investigators on those occasions when the formal investigators were unable to participate.

Regarding the selection of samples, this study aimed to ensure that the individuals were selected equally from the survey area, so the survey samples were selected by stratified random sampling. Based on the rural per capita net income level and economic development status of each town in the sample county, 2 towns were selected for each sample county, and thus a total of 12 towns were selected. In terms of economic development and distance from the township government of each sampled town, two sample villages were selected, totaling 24 sample villages. In each sample village, 20 households were randomly selected totaling 480 sample households.

In order to ensure the authenticity of participants' views and get valid data, before the interview, the investigators informed respondents about the "Privacy Statement" adopted for the survey. This included: (1) We do not represent any official organization, and your answers and the information you provide will only be used for scientific research. (2) The questionnaire is filled out anonymously, so please feel free to answer it.

After obtaining their permission to conduct the survey, we asked respondents to recall their experiences and answer the questionnaires. In order to minimize the expected problems associated with prejudice (such as recall bias and information bias), we paid attention to the justice and fairness of the content in terms of questionnaire design. Taking note of the sequencing of issues, problems and other factors, errors of priority context were avoided. Surveyors were carefully trained to pay attention to the wording of questions and to avoid wording that could have inhibited authentic answers.

Finally, 414 valid samples were obtained. Table 2 illustrates the basic information for the surveyed farmers. By comparing the data obtained from the survey with statistical data from the Hanzhong Statistical Yearbook, the Statistical Yearbook of Ankang City and the Statistical Yearbook of Shangluo, it was found that the samples were representative of the basic situation of farmers in those areas.

Table 2. Basic information for the sampled farmers.

Investigation Items	Category	Frequency	Proportion/%
Age(years)	≤25	56	13.52
	26~35	92	22.22
	36~45	135	32.61
	46~55	107	25.85
	≥55	24	5.80
Gender	Male	236	57.00
	Female	178	43.00
Family size (numbers)	≤2	27	6.52
	3~4	282	68.12
	5~6	96	23.19
	≥7	9	2.17
Income (Yuan)	≤10,000	75	18.12
	10,001~50,000	278	67.15
	50,001~100,000	55	13.29
	≥100,001	6	1.45
Educational level	Illiteracy	77	18.60
	Primary school	96	23.19
	Junior middle school	119	28.74
	High school and above	122	29.47
Types of farmers	Peasant household	94	22.71
	Part-time farmers	320	77.29

3.2. Measurement Set-Up

This paper draws on prior research, which informed our investigation of the current situation of Qinba Mountain Area in southern Shaanxi Province. It displays the direct impact of the set of poverty alleviation measures on sustainable livelihood capabilities of the farmers. It also shows the indirect impact on sustainable livelihood capability through appreciation of livelihood capital. We quantitatively measured the livelihood capital, the set of poverty alleviation measures and the sustainable livelihood capability of farmers, through selecting the core variables.

3.2.1. Livelihood Capital

This paper draws upon earlier research results from scholars, combined with the actual situation in Qinba Mountain Area in southern Shaanxi [37]. Table 3 shows the evaluation index system for farmers' livelihood capital.

Table 3. Description and definition of variables for measuring a farmer's livelihood capital.

Livelihood Capital	Variable	Definition and Description of Variables
Human capital	Age	20~29 = 2, 30~49 = 3, 50~59 = 1, 60~69 = 0.8
	Educational level	Primary school and below (1), junior high school (2), senior high school or secondary school (3), junior college (4), university and above (5)
	Health	Often ill (0), moderate (1), good (2), very good (3)
Physical capital	Number of livestock	Number of livestock
	Number of household fixed assets	Number of household fixed assets
	Housing situation	Number of rooms

Table 3. Cont.

Livelihood Capital	Variable	Definition and Description of Variables
Natural capital	Tillage area	Yield per unit area
Financial capital	Total income in the past year	Yuan
	Total savings	Yuan
	Was there any access to credit in the past?	Yes = 1 no = 0
	Could you borrow money from relatives and friends in the past?	Yes = 1 no = 0
	Has a donation been accepted in the past year?	Yes = 1 no = 0
Social capital	Has government provided any subsidy in past years?	Yes = 1 no = 0
	Are there any village council members in the family?	Yes = 1 no = 0
	If you disagree with the decision of the community meeting, will you object?	Yes = 1 no = 0
	Is there a spontaneous/economic cooperation organization in your village?	Yes = 1 no = 0
	Does any member participate in a cooperative organization?	Yes = 1 no = 0
	When faced with livelihood difficulties, how can your family get help?	Number of channels to get help such as government assistance
	Number of people you can trust in your administrative village	Almost no = 0 few = 1 half = 2 most = 3 almost all = 4
	Number of people you can trust outside your administrative village	Almost no = 0 few = 1 half = 2 most = 3 almost all = 4

3.2.2. Set of Poverty Alleviation Measures

This paper mainly investigates the implementation of poverty alleviation measures from three aspects: policy matching, staffing and capital investment. Table 4 indicates the manifestations and measurements of different poverty alleviation measures.

Table 4. Measurement system for different poverty alleviation measures.

Input	Variable Interpretation	Assignment
Poverty alleviation by relocation	Comprehensiveness, understanding and depth of policy propaganda	
Poverty alleviation by developing industries	Implementation dynamics	Extraordinary satisfaction (5), Satisfaction (4), No change (3), Dissatisfaction (2), Extraordinary dissatisfaction (1)
Poverty alleviation through e-commerce	Timeliness of execution	
Poverty relief through tourism	Organization building	
Poverty alleviation by developing education	Service evaluation	
Poverty alleviation by ecological protection	Deployment points	
Financial poverty alleviation	Poverty alleviation docking	
Social assistance in poverty alleviation	Total input	
Poverty alleviation through sci-techniques	Input category	

3.2.3. Sustainable Livelihood Capability

The existing literature includes livelihood capability indexing systems composed of social development, economic growth, productivity improvement, employment dynamics, ecological improvement, education accumulation, health assurance, security measures, etc. [38,39]. Based on existing research results and local actual conditions, this study set up indicators for the standard of living, welfare level, richness of opportunities for entertainment, income level, employment opportunities, ecological protection awareness, energy use and rural attachment. Table 5 quantitatively measures farmers' sustainable livelihood capability.

Table 5. Evaluation index of sustainable livelihood capability.

Evaluating Indicator	Indicator Meaning	Indirect Reflection	Assignment Description
Living standard	Safety of food and drinking water	Food richness; attention to drinking water safety	Significant decrease (1), Decrease (2), No change (3), Increase (4), Significant increase (5)
Welfare level	Welfare such as education and health care	Public welfare; free medical care; child welfare etc.	
Entertainment richness	Types of recreational activities	Recreation and sports activities	
Income level	Income level	Per capita income	
Employment	Employment opportunities	Employment diversity	
Ecological protection awareness	Farmers' awareness of environmental protection and ecological values	Protection of the natural environment, human lives and living environment, and the earth's organisms	
Energy utilization	Degree of clean and pro-environmental energy utilization	Utilization of clean energy such as wind power, biogas and biomass liquid fuel	
Rural attachment	Pride in and attachment to community and home	A sense of belonging and pride	

3.3. Model Setting

Our model is based on the research hypotheses and the influence patterns of the set of poverty alleviation measures on farmers' sustainable livelihood capability. The set of poverty alleviation measures and livelihood capital exhibit a direct influence on farmers' sustainable livelihood capability [40]. The set of poverty alleviation measures can also indirectly affect farmers' sustainable livelihood capability by supplying livelihood capital. Therefore, the following regression equation can be established:

$$SL_i = c + \alpha_1 I_i + \alpha_2 H_i + \alpha_3 N_i + \alpha_4 F_i + \alpha_5 S_i + \alpha_7 I_i H_i + \alpha_8 I_i N_i + \alpha_9 I_i F_i + \alpha_{10} I_i P_i + \alpha_{11} I_i S_i + \mu \quad (6)$$

In Equation (6), SL , c , I , H , N , F , P and S represent sustainable livelihood capability, constant items, the set of poverty alleviation measures, human capital, natural capital, financial capital, physical capital and social capital respectively, with α_i ($i = 1, 2, 3, 4 \dots$) as regression coefficients and μ as a residual term.

4. Results

4.1. Model Results of Direct Effect

Through the assessment of livelihood capital and the sustainable livelihood capability of farmers, it can be concluded that (see Figure 3): The most valuable livelihood capital of farmers is physical capital, with an average value of 0.571. Social capital has the widest variation, with a standard deviation of 0.248. The scarcest livelihood capital is natural capital, with an average value of 0.085. There is little difference in sustainable livelihood capability of farmers as a whole, with an average of 0.556.

The main effect regression results of livelihood capital and poverty alleviation measures on farmers' sustainable livelihood capability are illustrated in Table 6. We found that financial capital has a significant impact on the livelihood capability of farmers with an effect coefficient of 0.042, and the influence relationship passes the significance test. Natural capital has a negative impact on farmers' sustainable livelihood capability, with an impact coefficient of -0.087 . Natural capital is a resource and an environmental factor that may be used in rural poverty alleviation, but it shows a negative impact on livelihood capability in underdeveloped rural areas. According to this research on the impact of livelihood capital on livelihood capability, Hypothesis 1 and Hypothesis 2 are confirmed. Thus, livelihood capital has a significant impact on sustainable livelihood capability, but the extent to which each type of capital affects livelihood capability is different.

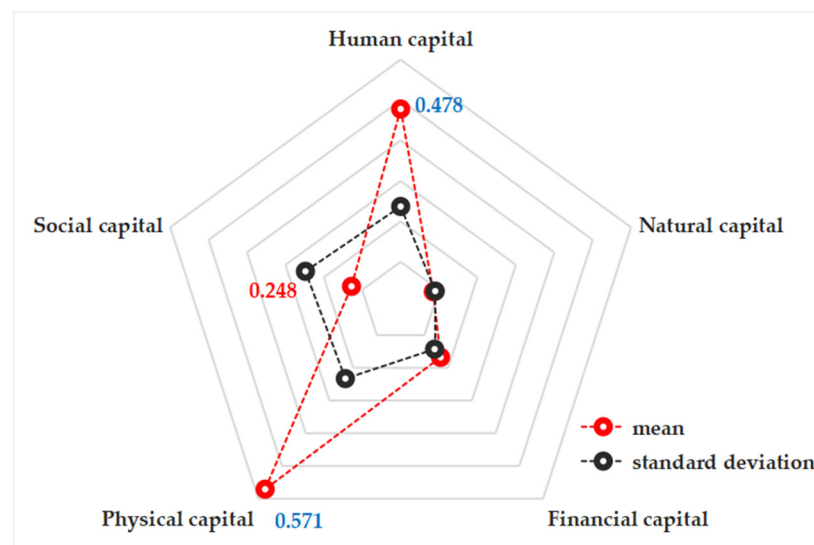


Figure 3. The assessment results for farmers' livelihood capital.

Table 6. The regression results for direct effect.

Variable	Coefficient	Standard Error	T-Statistics
Human capital	0.079	0.030	1.640
Natural capital	−0.087 *	0.078	−1.830
Financial capital	0.042 *	0.050	0.875
Physical capital	−0.015	0.031	−0.296
Social capital	0.022	0.029	0.449
Poverty alleviation by relocation	0.065	0.009	0.963
Poverty alleviation by developing industries	0.183 ***	0.010	2.630
Poverty alleviation through e-commerce	0.352 ***	0.013	3.751
Poverty relief through tourism	0.113	0.010	1.338
Poverty alleviation by developing education	0.090	0.009	1.607
Poverty alleviation by ecological protection	−0.066	0.010	−0.897
Financial poverty alleviation	0.195 **	0.011	2.123
Social assistance in poverty alleviation	0.081	0.010	1.176
Poverty alleviation through sci-techniques	0.065	0.013	0.704

Notes: * Significance at 10% level. ** Significance at 5% level. *** Significance at 1% level.

We also found that the set of poverty alleviation measures has a positive impact on farmers' sustainable livelihood capability. Only three kinds of measures, namely, poverty alleviation through e-commerce, financial poverty alleviation and developing industries have passed the significance test, with positive impact coefficients of 0.352, 0.195 and 0.183, respectively. Further, by comparing standardized regression coefficients, we find that poverty alleviation through e-commerce has the greatest positive effect on farmers' sustainable livelihood. That is, Hypothesis 3 is confirmed.

4.2. Model Results of Interaction Effect

The interaction effect model results are shown in Table 7. As a whole, poverty alleviation measures indirectly promote the improvement of sustainable livelihood capability of farmers through interaction with livelihood capital. Poverty alleviation by developing industry, societal assistance and sci-techniques improves the sustainable livelihood capability of farmers through the interaction of natural capital, with influence coefficients of 0.297, 0.270 and 0.391, respectively.

Table 7. Regression results for interaction effects.

Measures		Coefficient	Standard Error	T-Statistics
Poverty alleviation by relocation	Natural capital	−0.299 **	0.231	−2.106
	Financial capital	0.292 ***	0.111	2.723
	Poverty alleviation by relocation	0.329 *	0.023	1.791
	Poverty alleviation by relocation × Financial capital	−0.432 ***	0.037	−3.584
Poverty alleviation by developing industries	Natural capital	−0.355 ***	0.211	−2.747
	Financial capital	0.257 **	0.114	2.333
	Poverty alleviation by developing industries × Natural capital	0.297 **	0.076	2.190
	Poverty alleviation by developing industries × Financial capital	−0.362 ***	0.039	−2.985
Poverty alleviation through e-commerce	Poverty alleviation through e-commerce	0.336 *	0.025	1.808
	Poverty alleviation through e-commerce × Financial capital	0.224 *	0.042	1.891
Poverty relief through tourism	Financial capital	0.153 *	0.095	1.655
	Poverty relief through tourism	0.380 **	0.021	2.082
	Poverty relief through tourism × Financial capital	−0.252 **	0.034	−2.408
Poverty alleviation by developing education	Financial capital	0.276 **	0.139	2.044
	Poverty alleviation by developing education × Financial capital	−0.373 **	0.045	−2.583
Poverty alleviation by ecological protection	Financial capital	0.306 ***	0.115	2.737
	Poverty alleviation by ecological protection × Financial capital	−0.436 ***	0.044	−3.456
Financial poverty alleviation	Natural capital	−0.385 ***	0.221	−2.843
	Social capital	−0.237 **	0.069	−2.052
	Financial poverty alleviation × Natural capital	0.339 **	0.094	2.282
	Financial poverty alleviation × Financial capital	−0.212 *	0.037	−1.941
	Financial poverty alleviation × Social capital	0.273 **	0.024	2.223
Social assistance in poverty alleviation	Natural capital	−0.325 **	0.244	−2.170
	Financial capital	0.405 ***	0.123	3.403
	Social assistance in poverty alleviation	0.458 ***	0.025	2.620
	Social assistance in poverty alleviation × Natural capital	0.270 *	0.095	1.743
	Social assistance in poverty alleviation × Financial capital	0.550 ***	0.043	4.165
Poverty alleviation through sci-techniques	Natural capital	−0.432 ***	0.201	−3.504
	Poverty alleviation through sci-techniques × Natural capital	0.391 ***	0.094	2.917
	Poverty alleviation through sci-techniques × Financial capital	−0.246 **	0.041	−2.114

Notes: “×” represents interactive items. * Significance at 10% level. ** Significance at 5% level. *** Significance at 1% level.

For farmers with abundant financial capital, the interaction of assistance variables has a significant negative impact on farmers’ sustainable livelihood capability. For example, the interaction coefficient between “developing industry” and “financial capital” is −0.362, while the coefficient of interaction between “relocation” and “financial capital” on “sustainable livelihood capability” is −0.432. The positive influence of financial capital on farmers’ sustainable livelihood is weakened. Perhaps the cost of relocation or investing in industries is squeezing their financial assets, leading to a short-term loss of livelihood quality. It is worth noting that e-commerce has a positive impact on the sustainable livelihood capability of farmers, and can promote the sustainable livelihood capability of rural poor farmers by improving their financial capital, with the effect coefficient 0.224. Hypothesis 4, that a set of poverty alleviation measures indirectly affects farmers’ sustainable livelihood capability by affecting livelihood capital, is confirmed.

5. Discussion

This study comprehensively analyzed farmers’ livelihoods in a dynamic environment. The impact mechanism of the poverty alleviation measures on sustainable livelihood capability was identified.

The results of this study are consistent with Hypotheses 1 and 2, and consistent with the findings of Sewell et al., Krevel and others [41–47] that overall livelihood capital positively affects sustainable livelihood capability, but that different types of livelihood capital have different impacts on sustainable livelihood capability. However, in this study, we found that natural capital has a negative impact on sustainable livelihood capability. Further, rural areas are mostly located in complex and diverse natural conditions where various types of natural disasters occur frequently. Under the constraints of natural resources, reducing dependence on natural capital is key to effectively improving farmers’ sustainable livelihood capability. In addition, this study suggests that promoting healthy development

of rural finance is an effective way to improve the financial capital of rural people. Developing the financial capital of farmers in poverty-stricken areas is an important part of poverty alleviation—for example, increasing the employment opportunities for farmers. Social capital comprises non-institutionalized social norms and rules of cooperation established in the process of interaction. The government should focus on enhancing the accumulation of the social capital of farmers, and the community should actively play an important role in the organization, policy promotion and implementation of relevant actions. Approaches such as combining poverty alleviation measures with specific local industries need to be implemented to attract migrant workers back home to start businesses.

Research on livelihood capital and livelihood capability is quite abundant [48–52]. However, the existing “livelihood” research lacks a systematic analysis of the actual effects of poverty alleviation tools in the process of poverty alleviation and stabilization for poor households. This study found that poverty alleviation measures not only positively affect farmers’ sustainable livelihood capability, but also have an indirect impact through livelihood capital. This is consistent with Hypotheses 3 and 4. The results suggest that guiding cross-border e-commerce service enterprises to enter the countryside, fostering local enterprises and giving full play to the advantages of cross-border e-commerce can significantly improve the sustainable livelihood of farmers. The mode of “internet + rural tourism” has been developed to improve tourism infrastructure and public service facilities in poverty-stricken areas, and shows great performance. This effort should be conducive to the transformation of government assistance into self-reliance, poverty alleviation and wealth. We must take into account the fact that in various disadvantaged areas, farmers’ financial awareness is generally weak, and they are often in a passive state when responding to poverty alleviation measures. Meanwhile, there are relatively few financial products with poverty alleviation characteristics. In addition, there are objective difficulties such as the imperfect development of rural financial markets, inadequate financial systems and low-levels of infrastructure in mountainous areas. The government should strengthen financial support of projects in disadvantaged areas and actively promote innovation for financial products.

Compared with other studies, the additional contributions of this study are: First, this study systematically evaluated the effectiveness of poverty alleviation measures in improving the sustainable livelihood capability of farmers. Second, the impact of external poverty alleviation measures on the farmers’ sustainable livelihood capability is determined by complex processes, and is the result of the comprehensive influence of multiple factors. This study incorporates external poverty alleviation measures and farmers’ endogenous capital into a unified system for analysis. Third, this study takes the Qinba Mountain Area in southern Shaanxi as the research area. The study of this typical area provides a reference for stable poverty alleviation in similar areas in China.

Despite the useful explorations in this study, there are still some limitations to be overcome: research on synergistic effects of various poverty alleviation measures, analysis of regional differences and farmers’ heterogeneity, and multi-scenario drive mechanisms still needs to be carried out as soon as possible.

6. Conclusions

This study examined the impact of nine poverty alleviation measures and livelihood capital on sustainable livelihood capability from the perspective of farmers. Poverty alleviation through e-commerce, developing industry, and financial support are effective ways to improve livelihood capability. Financial capital has a great influence on livelihood capability, but the interaction between financial capital and some poverty alleviation measures shows a significant negative correlation with sustainable livelihood capability. The impact of external poverty alleviation measures on livelihood capability is a complex process which results from the overall impact of multiple factors. Therefore, in the post-poverty era, government should strengthen the development and tracking of farmers’ livelihood capital. While the government is implementing poverty alleviation and assistance, it will

be important to (i) continue paying attention to the mutual influence between assistance measures and farmers' livelihood capital, (ii) ensure timely effectiveness of assistance measures and, thereby, (iii) ultimately enhance the sustainable livelihood capability of farmers and eventually stability in raising the rural areas out of poverty.

China's experience in rural poverty alleviation shows that the comprehensive use of poverty alleviation measures can establish a diversified long-term mechanism for sustainable livelihoods. For developing countries, it is necessary to better coordinate various institutions participating in poverty alleviation. On the road to poverty reduction in rural areas, we should focus on finding incentives for farmers affected by different types of poverty, and around livelihood capital endowment. Through rational allocation of poverty alleviation tools, the livelihood levels in disadvantaged rural households may rise. After eliminating absolute poverty, it is more important to stabilize poverty alleviation.

Rural poverty is a social issue that is of worldwide concern, especially for developing countries. There is a huge demand for developing countries to learn from other countries' poverty reduction success stories and this demand is far from being met. In 2020, China was recognized as the country with the largest poverty reduction rate in the world and the first country to achieve the UN Millennium Development Goals. Since completing the task of eliminating absolute poverty in 2020, China has provided poverty alleviation for about 100 million people, and the poverty reduction goal in the UN 2030 Sustainable Development plan is ahead of schedule. Poverty alleviation in China under the guidance of the government reflects evident characteristics and advantages, and this experience has significance for rural poverty alleviation in other developing countries.

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