Influence of social capital on the livelihood strategies of farmers under China's rural revitalization strategy in poor mountain areas: A case study of the Liangshan Yi autonomous prefecture

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Abstract: Social capital in the form of social resources or social networks is one of the most important livelihood capital of farmers, which can increase the labor productivity of poor households and increase income. It is important to explore the reasons underlying the livelihood strategy choices of farmers from the perspective of social capital under China's rural revitalization strategy. In this study, the Liangshan Yi Autonomous Prefecture, a poverty-stricken mountainous area in southwestern China, was selected as the case study area, and multivariable linear regression models were constructed to analyze the influence of social capital on livelihood strategies. The results are as follows: (1) Individual social capital had a positive effect on non-agricultural livelihood strategies. On average, with a one-unit increase in individual social capital, the ratio of farmers' non-agricultural income to total productive income (*Income_Rto*) increased by 0.002% and 0.062%, respectively. Collective social capital, with the Peasant Economic Cooperation Organization (PECO) as the carrier, had a negative effect on the non-agricultural livelihood strategies of farmers; on average, with a one-unit increase in PECO, *Income_Rto* decreased by approximately 0.053%. However, this effect was only significant in the river valley area. (2) The income differences among the different livelihood strategy types were explained by the livelihood strategy choices of farmers. As non-agricultural work can bring more benefits, the labor force exhibited one-way migration from villages to cities, resulting in a lack of the subject of rural revitalization. It is necessary to implement effective measures to highlight the role of PECO in increasing agricultural income for farmers. Finally, based on the above conclusions, policy recommendations with respect to livelihood transformation of farmers and rural sustainable development are discussed.

1   Introduction

Livelihood strategies are the way in which farmers combine and use their assets or capitals to achieve livelihood goals (DFID 1999). Research on the livelihood capitals and strategies of farmers and the relationships between them can contribute to understanding of the livelihoods of farmers and formulation of measures to improve their livelihoods (He et al. 2017; Liu et al. 2018). Social capital, comprising social resources or social networks, is one of the most important livelihood capitals of farmers that can increase the labor productivity and income of poor households (Chantarat et al. 2007). It is important to explore the reasons behind the choice of livelihood strategies of farmers from the perspective of social capital for the transformation of their livelihoods and rural sustainable development.

Livelihood strategies, also known as livelihood choices, are ways in which farmers can combine and use their own livelihood assets. Livelihood strategies are generally measured in terms of the main types of livelihood activities or by the proportion of income from different livelihood activities (Soltani et al. 2012; Brown et al. 2006). Study of the factors that influence the livelihood strategies of farmers can help to strengthen the positive impact factors, reduce or eliminate the negative impact factors, and assist farmers to establish sustainable livelihood strategies. There are three main factors that affect the livelihood strategies of farmers: livelihood capital, livelihood vulnerability background, and family characteristics, including natural capital (Nawrotzki et al. 2012), agricultural land transfer (Guo et al. 2019), education, geographical location (Rahut et al. 2012a; Rahut et al. 2012b), socio-cultural context, physical resources (neighborhood context) (Bhandari 2013), settlement projects (Diniz et al. 2013), household size, additional working members (Jan et al. 2012), asset endowment, labor availability, and sex (male/female) of the household head (Rahut et al. 2017). Social capital is beneficial as it can bring new livelihood opportunities (Naithani et al. 2021) and has an important influence on non-agricultural employment, household income, and the livelihood strategy choices of farmers. Previous studies of the livelihood strategies of farmers from the perspective of social capital have focused on two aspects: 1) the impact of social capital on the non-agricultural employment of farmers, and (2) the impact of social capital on the income of migrant workers.

For micro-level farmers, social capital is the total amount of social resources embedded in the family social network. Social capital can not only compensate for the shortcomings related to the asymmetry of supply and demand information in the labor market, but can also enhance the trust between employers and employees and increase the non-agricultural employment opportunities of farmers. Social capital at the individual (household) level is also called "guanxi" in China (Fei et al. 1992; Zhang et al. 2003); "guanxi" is composed of family members, relatives, neighbors, colleagues, and other social networks. Social resources play an important role in the migration of labor (Hu 2007). Rural social resources such as fellowships, relatives, and classmates decrease the costs of materials, information, and psychology for migrant workers via "transfer, help, and bring," and this can increase the probability of villagers working outside the home. Relatives, friends, neighbors, and other "guanxi" resources can increase the likelihood that farmers engage in non-agricultural work and obtain a higher income. Further, different "guanxi" have different effects on the types of non-agricultural employment engaged in by farmers (Zhang et al. 2018).

When considering the sustainable livelihood of farmers, previous studies have discussed the influence of livelihood capital (e.g., human capital, physical capital, financial capital, natural capital, and social capital) on the livelihood strategies of farmers. Evidence indicates that social capital has a significant effect on farmers' livelihood strategy choices, with different social capitals having different effects on livelihood strategy choices (Fang et al. 2014; Xu et al. 2015). However, previous studies have not clearly classified social capital, and the measurement indicators used are open to questioning. For example, in some studies, "employment channel" and "the social network of relatives and friends available for assistance when seeking non-farm work" are used as proxy variables for social capital and their effects on non-agricultural employment have been evaluated. In these studies, the premise is the explanation of the cause of the findings based on the underlying paths; there have been no in-depth discussions on the effects of social capital on the livelihood strategies of farmers.

With respect to studies of the impact of social capital on the income of migrant workers, it is clear that the social network plays an important role in improving household incomes and alleviating

household poverty (Grootaert et al. 2002). Through dynamic optimization model analysis, it was found that the social network capital can serve as a supplement or substitute for physical capital and can increase the income level of poor families (Chantarat et al. 2012). Therefore, targeted public transfer payments can be used to help the poor accumulate social capital to escape poverty. Several studies have also examined social capital at the collective level of the village and its impact on the incomes of farmers. An analysis of Tanzanian farmers found that the social capital of the village was an important factor affecting household income. Family members in villages with more social capital were more likely to enjoy better public services, adopt better agricultural practices, have increased opportunities to participate in community activities, and make the use of credit to promote agricultural development (Narayan et al. 1999). Another study used a stratified linear model to estimate Chinese household incomes. The results showed that social capital at the village level had a significant influence on household income, and its influence varied by village type (Sato 2008). In the context of China's economic transformation, the use of personal social resource networks is more likely to result in higher-income jobs (Keister 2009). A previous study showed that social networks can indirectly affect the wage levels of migrant workers by affecting their type of work; this result was based on data from farmers in 22 provinces in China (Zhang et al. 2009). In another study, social capital was divided into two types: traditional "integrated" and modern "leapfrog," and an orderly response model was used to analyze survey data from the Pearl River Delta in China, which showed that the two types of capital were complementary and had significant positive influences on the incomes of migrant workers (Wang et al. 2013). In another survey of migrant workers in Beijing, the original social capital of migrant workers formed in the "native society" had no significant effect on their non-agricultural income, while the new social capital established after entering urban communities had a positive effect on migrants' incomes (Ye et al. 2010).

Social capital is considered the social network and reciprocal norms of individuals or groups, the subsequent resource sharing, and the mutual trust and interaction mechanisms (Putnam et al. 1993). It also comprises the social resources that can be involved or mobilized in purposeful actions (Lin 1999; Lin 2001). Social networks are a form of social capital; available social resources are the essential features of social capital. Based on the differences in research perspectives and opinions, academic research on social capital can be divided into two dimensions: individual and collective (Wang 2013). The individual dimension of social capital refers to the resources embedded in the social network of individual actors (Burt 2000). It mainly refers to how individuals invest and reap resources from their social network structure (Granovetter 1983; Lin 2001; Bian 2018). The collective dimension of social capital refers to a group or entire society, and emphasizes collective participation, shared norms, social trust, and mutual cooperation (Putnam 1993). Collective social capital improves overall operation efficiency via resource integration and coordination of the actions of the participating entities (e.g., farmers); its function is to improve the collective level of action of the group.

The individual social capital of farmers can be divided into two categories: traditional social capital, which is a network resource that is dependent on blood relationships, and extended social capital. Due to the closed nature of traditional rural society, the geographical relationship between neighbors is largely a projection of kinship in villages. Therefore, traditional Chinese rural social networks comprise relatives and are the innate social capital of farmers. With the advancement of China's urbanization process, the mobility of the rural population is increasing, and the radius of livelihood activities of farmers is increasing. The role of the network dependent on occupations, common interests, and other common experiences (such as workers, classmates, comrades, and so on) in rural areas is continuing to increase. Rural interpersonal relationships are closely linked to economic interests (He 2013) and the traditional relationship network is gradually expanding to form extended social capital. Social capital is dependent on a broad social division of labor (i.e., business relationship) and has a direct relationship with the social experience of the individual; it is a form of self-accepting social capital of the farmer.

Compared with traditional rural social capital, extended social capital has a strong rational component, with a wide spatial range, large geographical radius, and less overlap of information and resources. Therefore, due to the influence of urbanization and the market economy, the role of traditional social capital in the family social network is diminishing, and the role of extended social capital is

becoming increasingly prominent. The lower the level of social and economic development and the more remote the geographical position, the more significant the role of traditional social capital in rural interpersonal relationships becomes. Conversely, the higher the level of social and economic development and the better the geographical location, the more prominent the role of rural extended social capital in rural interpersonal relationships becomes.

Collective social capital emphasizes the collective effect of social networks, organizes dispersed individuals via certain formal reciprocal norms, and improves the efficiency of the entire group (Fisher 2013). In this way, individual goals can be realized in collective action. Several authors have constructed an indicator system from the dimensions of trust, norms, reciprocity, and participation in the network, have measured the collective social capital of a village, and proposed countermeasures to increase the collective social capital of farmers (Lu et al. 2014; Zhao et al. 2013; Xin et al. 2018). From the perspective of farmers' livelihoods, farmer cooperatives are an important carrier of rural collective social capital during agricultural and rural modernization. The PECO is mainly composed of farmers who are dependent on agriculture and entrenched in rural areas. Such a mutually supportive economic organization established by farmers voluntarily can effectively improve the organization of agricultural production and management, promote the organic connection between small farmers and modern agricultural development, and greatly improve agricultural incomes (Efendiev et al. 2013; Garnevska et al. 2011; Höhler et al. 2014; Jia et al. 2011; Liang et al. 2013; Mojo et al. 2017; Song et al. 2014; Bijman et al. 2011; Verhofstadt et al. 2015). By integrating rural resource elements, the PECO establishes mechanisms of cooperation, trust, and reciprocity so that farmers in rural areas who join the cooperatives can improve their family's livelihood. However, at present, some Chinese farmer cooperatives are formed under the impetus of administrative orders. The degree of organization, specialization, and industrialization are relatively low, and some have become empty shells or zombie cooperatives. Some remote and poor mountainous areas in China are still in the traditional agriculture development stage due to closed information systems, weak market awareness, low peasant education, and a low degree of commercialization of agricultural products. The degree of organization of farmers'

cooperatives is extremely low, and the influence of these cooperatives on the livelihoods of farmers is limited. In areas with better agricultural development conditions, the degree of development of farmers' cooperatives is higher, and the influence of these cooperatives on the livelihoods of farmers is more obvious.

At present, due to differences in labor income between the agricultural and non-agricultural sectors, the available literature on the livelihood strategies of farmers is mainly based on non-agricultural livelihood strategies or the diversification of livelihoods centred on non-agricultural livelihood strategies as the starting and foothold points. That is, studies have explored the mechanism and path underlying the use of individual social capital to achieve non-agricultural livelihood strategies. Too much emphasis on non-agriculturalization will inevitably ignore agricultural and rural development and will lead to further recession of rural development. Therefore, the available literature lacks a dialectical analysis of non-agricultural and agricultural livelihood strategies. Against the background of China's urbanization promotion and rural revitalization strategy, scholars must further consider how to build multi-dimensional rural social capital and sustainable livelihood strategies for farmers and promote the mutual progress of urbanization and rural revitalization strategies.

China's mountainous areas are concentrated in the western region and are generally considered areas with a high incidence of poverty. In general, poor mountainous areas are still dominated by traditional agriculture. The level of agricultural industrialization and modernization is low, and the ability to increase income is tenuous. Due to the low income associated with agricultural livelihoods in mountainous areas, expansion of non-agricultural livelihood activities through social networks is an effective way for farmers to increase their household income and reduce poverty (Fang et al. 2014; Xu et al. 2015). However, non-agriculturalization of livelihoods is a "double-edged sword". While it promotes transformation of the livelihood strategies of farmers from agricultural to non-agricultural strategies, alleviates the contradiction between man and the land, and increases the income of farmers, it also causes rapid non-agriculturalization of rural production factors represented by the labor force, which leads to weakening of rural development, a lack of rural endogenous development motivation,

and reduced self-development ability among farmers. Rural hollowing, aging, and non-agriculturalization caused by large-scale labor outflows are the main causes of recession in rural China (Wang et al. 2016). Therefore, in the process of urbanization and rural revitalization, dialectical relationships between farmers' social capital, livelihood strategies, and rural development must be considered in order to promote livelihood transformation of farmers and sustainable development in mountainous areas. The present study was undertaken in Liangshan Prefecture in Sichuan Province, a poverty-stricken mountainous area in Southwest China. The influences of different types of social capital on the livelihood strategies of farmers, and the differences among different rural settlements, were analyzed. The aim of this study was to provide a reference for promoting the sustainable livelihood of farmers, restructuring rural social capital, and promoting sustainable rural development in mountainous areas of China.

2   Study Area

Liangshan Yi Autonomous Prefecture (referred to as Liangshan Prefecture), in southwest Sichuan Province, is a typical poverty-stricken mountainous area in Southwest China. Its geographical position is 100°15′–103°53′ E and 26°03′–29°27′ N, and it contains the largest Yi ethnic group in China (Fig. 1). Liangshan Prefecture is a typical mountainous area with a maximum elevation of 5958 m and a minimum of 305 m. The relative height difference is 5653 m. The landforms in Liangshan Prefecture are complex and diverse. The mountains, river valleys, basins, and hills are interlaced, and the terrain is broken. The ecological environment is fragile, with natural disasters occurring frequently. Rural infrastructure is underdeveloped, and the rural poverty rate is high. This region is one of China's deep poverty-stricken areas (Cao et al. 2016). The mountainous areas are dotted with several mountain basins and river valley flat dams, which means that some mountain areas have certain characteristics of plain areas. This makes the problems associated with the mountainous area more complicated than those associated with the plain area. To explore the spatial differences in the factors that influence the livelihoods of farmers, in this study, the types of rural settlements were divided into three categories: high mountain villages, semi-mountain

villages, and river valley villages. These categories were based on the natural conditions and elevation of the village under question.

3   Method

3.1 Sample size and distribution

To objectively capture the differences in rural social and economic development and natural conditions in Liangshan Prefecture, the cluster stratified sampling method was used to select the study area. First, a county unit was used to construct a comprehensive index system that included social, economic, resource environment, and geographical features. The cluster analysis method was used to divide 17 county-level administrative units at the comprehensive development level into three groups: high, medium, and low. Then, one county was selected from each group using the stratified sampling method, and three sample counties were selected, namely, Xichang City (a county-level city), Mianning County, and Xide County. Each sample county had obvious differences in terms of landform type, location, rural
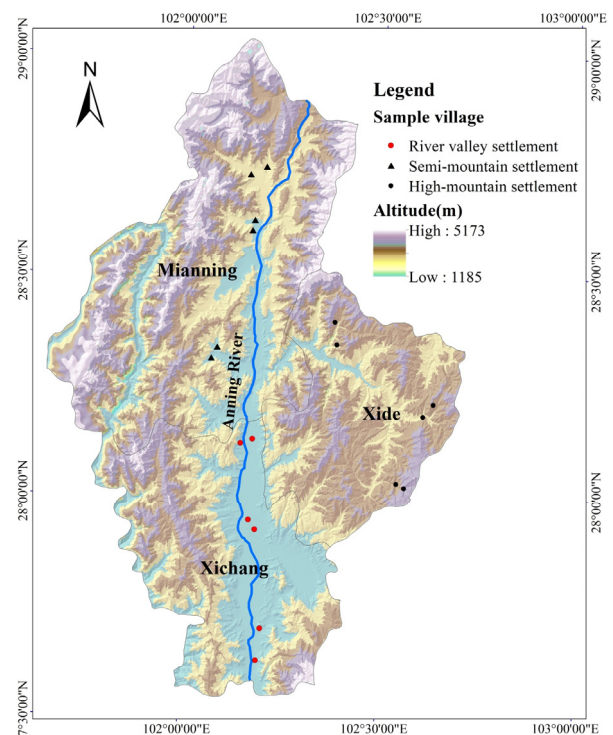

Fig. 1 Geographical location of the study area and distribution of sample villages in Liangshan Yi Autonomous Prefecture, Sichuan Province, China.

development, and ethnic composition. Most of the villages in Xide County are located in deep mountainous and high-altitude areas, with six villages randomly selected from the high mountainous area to represent high mountain villages. The villages in Mianning are mostly located in a semi-mountainous area, which is the transition region between the high mountains and the valley; this area has a higher altitude. Thus, six sample villages were selected from the bottom half of the mountainous area of Mianning to represent semi-mountain villages. Xichang City is in the middle section of the Anning River Basin; it has a lower altitude and better location conditions. There are many villages in the valley regions and their levels of development are similar. Six sample villages were randomly selected from the Xichang River valley to represent river valley villages. Thus, a total of 18 sample villages from Liangshan Prefecture were selected for the present study (Table 1, Fig. 1). Interviews were conducted primarily with teachers and students of Xichang College; this field research was conducted from January to May 2018 after relevant training. Household surveys were conducted by random sampling and participatory rural assessment, and were supplemented with small-scale interviews and interviews with village officials. A total of 25–30 households were interviewed in each village. In total, 521 households were surveyed. Questionnaires with incomplete information were deleted. Thus, a total of 508 valid questionnaires were obtained. Specifically, 159 complete questionnaires were obtained from the high mountain villages, 174 from the semi-mountain villages, and 175 from the river valley villages (Table 1).

3.2 Model specification

Based on the survey data obtained from farmers and the hypotheses described in the previous section, the following multivariable linear regression model was constructed:

$$Y = \beta_0 + \beta_1 social1 + \beta_2 social2 + \beta_3 social3 + X \times \gamma + \varepsilon \quad (1)$$

where, Y represents the livelihood strategy of farmers; β and γ are the factors to be evaluated; $social1$

Table 1 Characteristics of different types of villages and distribution of the sample of farmers in Liangshan Yi Autonomous Prefecture of 2018

Village type	Main features	Village	Num.	Prop. (%)	Income_Rto. (%)
High mountain	Altitude is more than 2200 m. The population is Yi people, which are composed of low labor education and skills; thus this area is the most backward of the mountainous areas. The ecological environment is fragile, with natural disasters occurring frequently, and infrastructure and public service facilities are backward. The incidence of poverty in villages is approximately 24%. Agriculture is dominated by traditional agriculture and animal husbandry. The characteristic agricultural resources in mountainous areas are abundant, but the degree of development is low.	Bajiu, Qiemu, Aluo, majue, Ahou and Zeguo	159	31.30	30.16
Semi-mountain	Altitude is from 1700 to 2200 m. These areas are the mixed areas of Yi and Han nationalities, and the social economy is in the middle level in the mountainous areas. The quality of labor force, transportation, and public services are slightly better than those in high mountain areas, but they still lag far behind the valley areas. The incidence of poverty in villages is approximately 11.5%. Agriculture is dominated by traditional agriculture, which is suitable for planting cash crops such as flue-cured tobacco and walnut.	Tianba, Dianzi, Shaba, Pofu, Boluo and Sanlian	174	34.25	41.50
River valley	Altitude is less than 1700 m. These areas are all inhabited by Han people, and are the quintessence of social and economic development in mountainous areas. Labor quality, transportation, public service, and market awareness are the highest among the three types of villages. The incidence of poverty in villages is less than 1%. The endowment of agricultural resources is good. Modern agriculture has taken shape. Grape, onion, pomegranate, and other cash crops have achieved specialized production.	Fenghuang, Baizhi, Xinhua , Anning, Luma and Dade	175	34.45	57.26
Total			508	100	43.38

Notes: Num., Number of sampling households; Prop., Proportion of sampling distribution; Income_Rto., Ratio of non-agricultural income (to household income).

represents traditional social capital, used to verify hypothesis 1, and its coefficient β_1 was expected to be positive; *social*2 represents extended social capital, used to verify hypothesis 2, and its coefficient β_2 was expected to be positive; *social*3 represents rural collective social capital, used to verify hypothesis 3, and its coefficient β_3 was expected to be negative; X is the main control variable and ε is the random disturbance item. In the present study, two proxy variables for the livelihood strategy of the farmer were selected as the dependent variables (Y): the livelihood type (LS_*Type*) and the ratio of non-agricultural income (*Income_Rto*). The livelihood type was a binary categorical variable, and when used as a dependent variable in the benchmark model, the model parameters were estimated using logit and probit methods. The ratio of non-agricultural income was a continuous variable, and when used as a dependent variable to test for robustness, the ordinary least squares method was used to estimate the model parameters.

In addition, the present study was concerned with the endogeneity between variables and thus, the following strategies were used to mitigate the effects of endogeneity: (1) Proxy method: the factors that may affect the livelihood strategy of farmers were all included in the model as proxy variables to minimize the endogeneity caused by the "missing variable" problem (Table 2). (2) Pre-determined variable method: considering the possible two-way interactions between the core explanatory variables (types of social capital) and the interpreted variable (livelihood strategy), the core explanatory variables were all delayed by one period.

3.3 Variable and data description

3.3.1 Dependent variables

The livelihood strategies of farmers were expressed by the livelihood strategy type (LS_Type) in 2007 and the ratio of non-agricultural income to total income (Income_Rto). To simplify the analysis, the present study divided the types of livelihood strategies into agricultural-dependent livelihood strategies and non-agricultural-dependent livelihood strategies. When the family agricultural income accounted for more than 50% of the total household productive income, it was denoted as an agricultural-dependent livelihood strategy and LS_Type was assigned a value of 0; whereas, when the family agricultural income

accounted for less than 50% of the total household productive income and non-agricultural income was greater than 50%, it was denoted a non-agricultural-dependent livelihood strategy and LS_Type was assigned a value of 1. The income structure of the farmers was also used to reflect their livelihood strategies. The ratio of non-agricultural income to the total productive income (Income_Rto) was adopted for the robustness test.

3.3.2 Key explanatory variables

Currently, the rural areas in China are gradually transforming from traditional "acquaintance societies" (Fei 1992) to modern rural societies. The social capital of rural families is also transforming from traditional single social capital to multi-dimensional social capital. The present study divided the social capital of farmers into the following three categories: traditional social capital (*social*1), extended social capital (*social*2), and collective social capital (*social*3).

(1) Traditional social capital (social1). Emotion is the bond of this type of social capital. To maintain this type of emotion, the interaction or investment between the family and other families is directly reflected in the income and expenditure on gifts (Yan 1998). Based on the survey data, the income from gifts was large, and the proportion of family members receiving gifts was relatively small. Gift money expenditure is relatively stable, and the gifts or money that a family gives to relatives and friends can be regarded as family investment and maintenance of social networks. Gift money expenditure (including goods and cash expenditure) can reflect the scale, linkage strength, and support capacity of the social network of farmers. Therefore, the present study used gift money expenditure in 2016 (*gift*) as a proxy variable for the traditional social capital of farmers.

(2) Extended social capital (social2). Compared with traditional social capital, extended social capital has a strong rational component. This social capital has instrumental characteristics and people need to invest in acquiring it. Communication and liaison expenditures are the main investment forms of extended social capital, including gift money expenditure, communication expenses, and party expenses. Therefore, the present study used friends' exchange expenditure in 2016 (*spending*) to measure the extended social capital of farmers. *Social1* and *Social2* are considered individual social capital. According to hypothesis 1 and hypothesis 2, the

Table 2 Descriptive statistics of variables of the sample of farmers in Liangshan Yi Autonomous Prefecure

Variable		Unit	Definition and assignment	Min	Max	Mean	SD
Livelihood strategy	LS_Type	-	Livelihood strategy type	0.00	1.00	0.48	0.50
	Income_Rto	%	Ratio of the non-farm income to the gross household income	0.00	0.99	0.43	0.28
Traditional Social Capital (social1)	gift	10^2RMB[a]	Gift expenditure	0.50	56.00	11.91	7.20
Expanded social capital (social2)	spending	10^2RMB[a]	Friends' exchange expenditure	0.00	30.50	2.88	3.83
Collective Social Capital (social3)	PECO	-	Participation in the Peasant Economic Cooperation Organization (1, 0)	0.00	1.00	0.31	0.47
Human capital	health	-	The average health status of labor. According to the five options of "excellent", "good", "medium", "poor" and "disability" given by the questionnaire, the values were "5", "4", "3", "2", and "1" to evaluate the health status of the family labor force, and then take the average.	1.00	5.00	4.19	0.74
	education	year	Average education level of labor	0.50	11.50	5.70	2.83
	train	%	Proportion of labor force who have participated in agricultural skilled training	0.00	1.00	0.24	0.27
Financial capital	cashincome	10^4RMB[a]	Annual household cash income per capita	0.14	6.35	1.36	1.03
Natural capital	arableland	ha	Per capita arable land area	0.03	0.44	0.11	0.07
	forestland	ha	Per capita forestland area	0.00	0.68	0.26	0.22
Physical capital	fixedassets	10^4RMB[a]	Current market value of all the fixed assets that a household possesses	1.58	33.50	7.76	5.68
Family characteristic	minority	-	Are they minority farmer? If yes, assign 1; if not, assign 0.	0.00	1	0.53	0.50
	cadre	-	Whether there is family member as cadre? If yes, assign 1; if not, assign 0.	0	1	0.14	0.35
	laborage	year	Average age of household labor force	25.00	65.00	41.98	8.93
	laborage²	year²	Square of average age of household labor force	625	4225	1842	812
	Dep_Rto	-	Population dependency ratio	0.00	4.00	0.72	0.59
Village characteristic /Village accessibility	dis	km	Distance from the village committee to the county government	11.80	56.60	32.67	13.66
	time_dis	hour	Time from the village committee to the county government by the most commonly used means of transport	0.32	4.01	1.23	0.88
	altitude	m	Average altitude of village	1470	3102	2023	480

Notes: [a], During the study period, 1US dollar was approximately equal to 6.6 RMB.

symbols of *Social1* and *Social2* are expected to be positive.

(3) Collective social capital (social3). Constructing rural collective capital (a rural social organization) that is compatible with the market economy and urbanization is an inevitable requirement of rural transformation and an inherent requirement for the revitalization of rural China. Rural collective capital is conducive to the development of modern agriculture and rural areas; it is a trust and cooperation relationship established through reliance on contracts and institutions. The present study used participation in the PECO in 2016 to measure the collective social capital of farmers (*social3*). If the

family participated in the professional cooperative organization, then *socail3* = 1; if they did not participate, then *social3* = 0.

3.3.3 Control variables

To ensure the rigor of the hypothesis tests and estimation results, in addition to the social capital-related independent variables, control variables, including other livelihood capitals of farmers and family characteristics, were added to the models. These control variables included human capital, financial capital, natural capital, physical capital, and other family livelihood capital variables, as well as family characteristic variables and village characteristic

variables. The control variables were all selected from the 2017 survey data obtained from farmers. The descriptive statistics for these variables are shown in Table 2.

4 Results

4.1 Full sample regression results

The present study focused on the influence of family social capital on the livelihood strategies of farmers. Livelihood strategy was a binary virtual variable; therefore, logit and probit methods were used to estimate the parameters. Table 3 shows the estimation results, with columns 1 and 4 containing the estimated results using the logit model, and column 5 containing the estimated results using the probit model. First, the control variables were added to the regression model with the different core explanatory variables, namely, the variables related to the types of social capital (i.e., traditional, extended, and collective). The variables *gift* and *spending* had significant positive effects on the non-agricultural-dependent livelihood strategies of farmers at the 1% and 5% levels. PECO had a negative effect on the non-agricultural-dependent livelihood strategies of farmers; however, this was not significant. Then, the three different social capital variables were included in the model, and logit and probit estimates examined. The pseudo R² values of the models reached 0.552 and 0.547, respectively; therefore, the goodness of fit of the models was improved; the results obtained from the two models were similar (Table 3). The coefficients of *gift* and *spending* remained significantly positive, and the coefficient of *PECO* was insignificantly negative. Therefore, traditional social capital and extended social capital were beneficial to farmers when choosing non-agricultural livelihood strategies. This finding is consistent with that of previous studies (Yin et al. 2020; Naithani et al. 2021). Rural collective social capital (the PECO) had a positive effect on the choice of agricultural livelihood strategy; however, this was not significant. Thus, the study results were consistent with the hypotheses.

With respect to the control variables related to livelihood capital, the coefficient of *health* was positive but was not significant. The coefficients of *education* and *training* were significantly positive; therefore, the education level of the family labor force and their non-

agricultural skills training had positive effects on the non-agricultural livelihood strategies of farmers, whereas physical health had a limited influence on the choice of non-agricultural livelihood strategies. The coefficient of *cashincome* was significantly positive; therefore, with an increase in household available funds (financial capital), farmers were more inclined to engage in non-agricultural production, meaning they were more likely to go out to work or work on non-agricultural operations. The possibility of choosing non-agricultural-dependent livelihood strategies was therefore greater. The coefficient of *arableland* was significantly negative; therefore, the higher the amount of cultivated land owned by the family, the more likely the family was to choose an agricultural livelihood strategy, which is consistent with the conclusions of previous studies (Xu et al. 2015; Fang et al. 2014). The coefficient of *forestland* was not significant; therefore, forest resources in mountainous areas were not effectively exploited and utilized, and resource advantages had not been translated into economic benefits. The coefficient of *fixassets* was negative but non-significant; therefore, there was no obvious influence of physical capital on the livelihood strategy choices of farmers.

In terms of the control variables related to family characteristics, the coefficient of *minority* was significantly negative; therefore, the degree of non-agriculturalization of ethnic minority families was relatively low. The coefficient of *cadre* was significantly positive at the 10% level; therefore, the families with members of cadres were more easily able to obtain non-agricultural employment information, and the chance of these members engaging in non-agricultural livelihood activities was greater. The coefficient of *laborage* was significantly positive and the coefficient of *laborage²* was significantly negative; therefore, there was an inverted U-shaped relationship between the average age of household labor and the choice of non-agricultural livelihood strategies. Because young and middle-aged rural laborers have greater advantages in terms of engaging in non-agricultural livelihood activities than older laborers, the average age of family labor had a positive influence on the choice of non-agricultural livelihood strategies among the younger age group. With an increase in age, the effect of age of labor on non-agricultural livelihoods gradually weakened. After reaching a certain turning point, it showed a negative trend; that is, elderly laborers tended to choose agricultural livelihood

Table 3 Full sample regression analysis results of influencing factors of livelihood strategy

Dependent variables: LS_type (Livelihood strategy type)					
Method	Logit	Logit	Logit	Logit	Probit
Model	(1)	(2)	(3)	(4)	(5)
gift	0.004**			0.003*	0.002*
	(0.002)			(0.002)	(0.001)
spending		0.005***		0.005**	0.003**
		(0.001)		(0.002)	(0.001)
PECO			-1.087	-0.664	-0.375
			(0.734)	(0.456)	(0.285)
health	1.482***	1.531***	1.325***	1.735***	0.957***
	(1.239)	(1.247)	(1.221)	(1.294)	(0.654)
education	0.293***	0.182***	0.265***	0.187**	0.098**
	(0.072)	(0.066)	(0.066)	(0.082)	(0.046)
train	4.345***	4.983***	4.732***	4.368***	2.815***
	(0.927)	(1.112)	(0.970)	(1.076)	(0.578)
cashincome	0.198**	0.154**	0.165**	0.158**	0.107**
	(0.071)	(0.069)	(0.067)	(0.076)	(0.045)
arableland	-0.799**	-0.837**	-0.632**	-0.838**	-0.468**
	(0.331)	(0.352)	(0.264)	(0.399)	(0.202)
forestland	-0.048	-0.125	-0.010	-0.138	-0.062
	(0.119)	(0.127)	(0.119)	(0.142)	(0.078)
fix_assets	-0.105	-0.102	-0.111	-0.238	-0.120
	(0.240)	(0.153)	(0.149)	(0.256)	(0.129)
minority	-0.419*	-0.563*	-0.265*	-0.443*	-0.049*
	(0.243)	(0.325)	(0.149)	(0.247)	(0.027)
cadre	0.152*	0.145*	0.173*	0.254*	0.146*
	(0.081)	(0.079)	(0.087)	(0.143)	(0.078)
laborage	0.740**	0.710**	0.776**	1.197**	0.648**
	(0.386)	(0.370)	(0.412)	(0.665)	(0.289)
laborage²	-0.009**	-0.008**	-0.009**	-0.015**	-0.007**
	(0.004)	(0.004)	(0.004)	(0.063)	(0.003)
dep_rto	-0.017*	-0.479*	-0.176*	-0.235*	-0.117*
	(0.009)	(0.265)	(0.097)	(0.132)	(0.062)
dis	-0.003*	-0.004*	-0.003*	-0.002*	-0.002*
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
time_dis	-0.093*	-0.017*	-0.075*	-0.186*	-0.065*
	(0.051)	(0.010)	(0.0392	(0.010	(0.0374)
altitude	-0.001**	-0.001**	-0.001**	-0.001**	-0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
consant	-12.725***	-11.768***	-10.889***	-11.124***	-10.075***
	(1.625)	(1.305)	(1.449)	(1.521)	(1.720)
N	508	508	508	508	508
Pseudo R^2	0.391	0.425	0.381	0.552	0.547
chi²	131.248	134.800	161.219	129.004	176.013

Notes: Standard errors in parentheses, $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

strategies, and thus, the agricultural labor force exhibited an aging trend. The coefficient of *Dep_Rto* was significantly negative; therefore, the higher the family dependency ratio, the greater the family burden, the less labor available for the family, the more difficult it was to carry out livelihood division, the less likely it was that family members would go out to work, and the less likely it was for farmers to choose non-agricultural livelihood strategies. In terms of village characteristics, the coefficients of *dis*, *time_dis*, and *altitude* were significantly negative; therefore, remote locations were

associated with decreased information exchange between farmers and the outside world. Reduced traffic infrastructure and long travel times further increased the travel cost and transaction cost of the labor force. In general, villages in high-altitude areas are generally in remote locations and have poor transportation infrastructure, which decreased the non-agricultural employment opportunities of these village farmers.

4.2 Sub-regional sample regression results

The socio-economic development conditions and development levels of the different types of villages differed. The effect of family social capital on the livelihood strategies of farmers might vary between different types of villages. To further verify the previous hypotheses and explore the impact mechanism of social capital in different villages, the present study divided the sample of farmers into those living in high mountain villages, those living in semi-mountain villages, and those living in river valley villages. The evaluation results of the logit and probit models are shown in Table 4. Because of the differences in geographical conditions and socio-economic development levels, the effects of social capital on the livelihood strategies of farmers varied by village type.

In the high mountain villages, the coefficient of *gift* was significantly positive at the 1% level, being the largest and most significant among the three village types. The other social capital indicators were not significant. Owing to decreased economic development, the relatively closed information, the narrow daily activities of the farmers, and the small foreign exchanges in the high mountain areas, the interpersonal cooperation and trust radiuses were small. Traditional social capital, which is dependent on kinship and geography, was dominant, and the farmers mainly acquired non-agricultural employment opportunities based on traditional relationship networks. Therefore, traditional social capital had a significant effect on the livelihood strategies of farmers.

In the semi-mountain villages, the coefficients of *gift* and *spending* were significantly positive at the 5% level; however, the coefficient of PECO was not significant. Traditional social capital had a certain effect on the non-agricultural employment of farmers; however, its influence was lower than that of the high mountain villages. The geographical location of the semi-mountain villages is better than that of the high mountain villages, and these locations are more influenced by China's urbanization. The farmers have more exchanges with the outside world and their social circles are relatively large. In this case, the social networks of farmers were not limited to traditional social capital; thus, extended social capital had a significant effect on non-agricultural employment. Although the PECO plays a role in the specialization of agricultural production in the semi-mountain villages, its effect on the livelihood strategies of farmers was not significant.

In river valley villages, the coefficient of *gift* was positive but not significant. The coefficient of *spending* was significantly positive at the 1% level and the coefficient of PECO was significantly negative at the 5% level. The river valley has a flat terrain, convenient transportation, good geographical location, excellent agricultural resources, high agricultural specialization, and a high degree of marketization. Thus, within this mountainous area, the river valley is the best area for social and economic development. Influenced by urbanization and marketization, the rural population in the river valley district is more mobile. Traditional social capital had a reduced effect on non-agricultural employment, with a non-significant effect on the livelihood strategy selection of farmers. Extended social capital significantly influenced the livelihood strategies of farmers, and their cultural levels were relatively high. The employment information acquisition channels were increasingly diversified, and the ability to judge external information was strong.

Table 4 Regression analysis results of samples of influencing factors of livelihood strategy in different village types

Dependent variables: LS_type (Livelihood strategy type)						
Village type	High-mountain village		Semi-mountain village		River valley village	
Method	Logit	Probit	Logit	Probit	Logit	Probit
Model	(1)	(2)	(3)	(4)	(5)	(6)
gift	0.005***	0.004***	0.003**	0.004**	0.003	0.003
	(0.001)	(0.001)	(0.001)	(0.002)	(0.016)	(0.021)
spending	0.020	0.012	0.003**	0.002**	0.009***	0.004***
	(0.027)	(0.024)	(0.001)	(0.001)	(0.002)	(0.001)
PECO	-0.706	-0.444	-0.960	-0.629	-1.306**	-0.880**
	(0.650)	(0.414)	(0.870)	(0.524)	(0.611)	(0.369)
constant	-9.962**	-11.066**	-10.537**	-9.879**	12.453**	10.501**
	(1.502)	(1.659)	(1.512)	(1.291)	(1.810)	(1.450)
Control variable	Y	Y	Y	Y	Y	Y
N	159	159	174	174	175	175
pseudo R^2	0.443	0.449	0.259	0.250	0.631	0.601
chi²	65.210	80.719	23.844	30.693	27.520	34.252

Notes: Standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

When individuals sought employment opportunities, in addition to using their family social capital, some farmers also obtained non-agricultural employment information via the Internet. The PECO in the river valley area played an important role in highlighting the advantages of agricultural resource endowment, promoting adaptation to the needs of modern agricultural development, and improving the degree of agricultural industrialization, specialization, and organization. The survey indicated that the specialization of farmers in the river valley villages played a substantial role in increasing the income of these farmers; this is beneficial for those farmers who love agriculture and rural areas, and who have mastered agricultural production skills, allowing them to exert their competitive advantage. Farmers who joined the PECO not only broke through their traditional social network and social capital, but also obtained social network resources related to the production, processing, and circulation of agricultural products. Therefore, the PECO had a significant positive influence on the agricultural-dependent livelihood strategies of farmers who joined it, i.e., rural collective social capital.

The regression results for the control variables were consistent with the results obtained using the total sample; due to space limitations, these will not be repeated here.

4.3 Robustness test

To determine whether the total sample regression results and sub-regional sample regression results were credible, a robustness test was required. This is because the use of ordered categorical variables to measure livelihood strategies might be biased. For example, one farmer's agricultural income may account for 49% of their total income and their non-agricultural income may account for 51% whereas another farmer's agricultural income may account for 1% and their non-agricultural income for 99%. In terms of the type of livelihood strategy, both farmers would be considered non-agricultural-dependent farmers and would be assigned a livelihood strategy value of 1 in the regression analysis; however, there are obvious differences in the livelihood structures of these two farmers, and this may lead to bias in the analysis results. Therefore, in this section, the percentage of non-agricultural income to total income (Percentage) of households was utilized as a second proxy variable

for the livelihood strategy of farmers in order to conduct the robustness test. Because Percentage was a continuous variable, the ordinary least squares method was used to estimate the parameters for the explanatory variables. On average, for every one-unit increase in traditional and extended social capital, the ratio of non-agricultural income of farmers to total productive income (*Income_Rto*) increased by 0.002% and 0.062%, respectively. For every one-unit increase in PECO, the proportion of non-agricultural income of farmers to total income (*Income_Rto*) decreased by approximately 0.053%; however, this was only statistically significant in the river valley area.

Compared to Tables 3 and 4, Table 5 shows that the significance of the effects of the three different types of social capital on farmers' livelihood strategies was improved and the direction of the variables' influences remained the same. Therefore, different types of social capital had different effects on the livelihood strategies of farmers, and there were significant differences in the effects of social capital on livelihood strategies as a function of the different types of villages.

5 Discussion

China's mountainous areas are the largest and most concentrated areas of poverty. Therefore, increasing household income and removing poverty are the primary goals and desires of farmers. To alleviate poverty in the market economy environment, farmers who are rational, "economic people" will inevitably use the family's livelihood resources and various opportunities in their environment to choose a livelihood strategy that will create higher income levels for their household. The present study aimed to further explain the effects of social capital on the livelihood strategy choices of farmers by examining the differences in income between agricultural-dependent and non-agricultural-dependent farmers.

The per capita net income of the farming households generally followed a normal distribution. Independent samples t-tests were used to compare the per capita income of farmer households of different livelihood types. Contrast analysis was performed with the income of agricultural-dependent farmers as the reference group (Table 6).

For the overall mountainous area (total sample), the per capita net income of non-agricultural-

dependent farmers was significantly greater than that of agricultural-dependent farmers at the 5% level. Owing to the lower returns from agricultural livelihoods, to obtain higher family income and improve living standards, farmers used the family's individual social network capital (traditional and extended social capital) to seek opportunities for non-agricultural employment.

In the high mountain and semi-mountain villages, the average income of agricultural-dependent farmers was much lower than that of non-agricultural-dependent farmers (significant at the 1% level). The agricultural resources were not effectively developed. The commercialization rate of the agricultural products and the household income were low. To alleviate poverty, farmers used their social network capital to find opportunities to go out to work and increase their ratio of non-agricultural income to agricultural income. To increase household income, farmers used social capital at the family level to engage in non-agricultural-dependent livelihood strategies. Owing to the low income of the agricultural livelihood strategy, the influence of rural collective social capital (i.e., the PECO) on the livelihood strategy choices of farmers was not obvious.

In the river valley villages, agricultural resources are high and agricultural products are highly marketized. The per capita net income of the agricultural-dependent farmers was greater than that of the non-agricultural-dependent farmers; however, the difference was not statistically significant. Some farmers with non-agricultural skills used individual social capital to obtain non-agricultural employment opportunities and chose non-agricultural-dependent livelihood strategies; some farmers with agricultural production skills chose to engage in agricultural livelihood activities and join farmers' cooperatives to obtain rural collective social capital in order to meet the needs of the market economy and contribute to agricultural modernization. Thus, social capital tended to play different roles in the livelihood activities of rational farmers. When non-agricultural livelihood income was significantly greater than agricultural livelihood income, farmers with more individual social capital actively chose non-agricultural livelihood strategies, and farmers with a lack of individual social capital passively chose agricultural livelihood strategies. Farmers who joined the PECO had the advantage of collective social capital and tended to choose agricultural livelihood strategies.

The types of livelihood strategies can be subdivided into pure agricultural, non-agricultural, part-time agricultural, and other. In future research, the types of livelihood strategies of farmers will need to be examined in depth according to the research needs and the characteristics of the different regions. Against the background of China's Rural Revitalization Strategy and urbanization strategy, the best pay to utilize social capital, promote a two-way flow of urban and rural resources, and promote the sustainable development of agriculture and rural areas are worthy of further discussion.

Table 5 Robustness Test on regression analysis results of influencing factors of livelihood strategy (OLS)

Dependent variables: Income_Rto. (ratio of non-agricultural income)				
Village type	Total	High-mountain village	Semi-mountain village	River valley village
Model	(1)	(2)	(3)	(4)
gift	0.002** (0.001)	0.041*** (0.007)	-0.003** (0.001)	-0.020 (0.043)
spending	0.062** (0.029)	0.021 (0.019)	0.011*** (0.003)	0.079*** (0.022)
PECO	-0.053 (0.067)	-0.002 (0.038)	0.036 (0.031)	-0.072*** (0.033)
constant	-0.796*** (0.216)	-0.317* (0.183)	0.710* (0.432)	-2.548*** (0.814)
N	508	159	174	175
R^2	0.638	0.774	0.758	0.753
F	48.051	71.343	41.756	48.610

Table 6 Per capita net income of rural household of the sample of farmers in Liangshan Yi Autonomous Prefecture

	High mountainous village (RMB)	Semi-mountainous village (RMB)	River valley village (RMB)	Average (RMB)
Agriculture-dependent farmers	4300.55 (101 households)	6687.32 (91 households)	20107.13 (70 households)	9379.39 (262 households)
Non-agriculture-dependent farmers	7346.43*** (58 households)	13308.33*** (83 households)	19966.61 (105 households)	13848.29** (246 households)

Notes: Sample number in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

6 Conclusions

This study was undertaken in Liangshan Prefecture in Sichuan Province, a poverty-stricken mountainous area in Southwest China. We divided the farmers' livelihood types into non-agricultural-oriented and agricultural-oriented, and explores the influence of different types of social capital on the livelihood strategies of farmers and their differences among different rural settlements. Based on the analysis, two main conclusions can be drawn:

(1) Social capital has an important influence on the livelihood strategy selections of farmers in mountainous areas. Different types of social capital have different effects, with obvious spatial differences also observed: a) Individual social capital, categorized into traditional and extended social capital, had a positive effect on non-agricultural livelihood strategies. The effect of traditional social capital was the most significant in the high mountain villages, and the effect in the river valley villages was non-significant. The effect of extended social capital was the most significant in the river valley villages, and the effect in the high mountain villages was non-significant. b) Collective social capital with the PECO as a carrier had a negative effect on the non-agricultural livelihood strategy choices of farmers; however, this was only significant in the river valley villages.

(2) The income difference between the different livelihood strategy types was the reason farmers chose different livelihood strategies. Non-agricultural work can bring more benefits; therefore, the labor force exhibited one-way migration from villages to cities, resulting in a lack of rural development. It is necessary to adopt effective measures to highlight the role of farmers' cooperatives in increasing income for farmers, thus enhancing the attractiveness of agriculture and rural areas.

To date, while there are many studies of non-agricultural employment and the non-agricultural income of farmers from the perspective of social capital (Zhang et al. 2018; Hu 2007; Grootaert et al. 2002; Chantarat et al. 2012), studies of the livelihood strategies of farmers from the perspective of social capital are limited. Further, different types of villages have different levels of socio-economic development due to differing geographical resources, and there are differences in the role of social capital in the livelihood strategies of farmers from different types of villages. At present, there is limited research regarding the spatial differences in the factors that affect the livelihood strategies of farmers. Therefore, the theoretical significance of this study is as follows. First, the social capital of farmers was divided into three categories: traditional, extended, and rural collective social capital. Using econometric methods, quantitative analysis of the effects of these different types of social capital on the livelihood strategies of farmers was undertaken. Second, the rural settlements in the case region were divided into different types, and the influences of livelihood capital on the livelihood strategies of farmers in the different types of villages were analyzed.

In addition to the theoretical significance of these findings, there are also important policy implications. In the context of China's rapid urbanization and rural revitalization (Xi 2017), it is necessary to synergistically promote the livelihood transformation of rural households to achieve sustainable rural development (Long et al. 2016; He et al. 2017).On the one hand, repairing and strengthening traditional rural social capital and promoting the orderly transfer of rural labor to cities and towns to achieve transformation of the livelihoods of some farmers to non-agricultural livelihoods are required. On the other hand, promoting rural collective social capital, enhancing the cohesiveness of rural development, attracting a greater labor force, and promoting sustainable development of agriculture and rural areas are also necessary. Based on the characteristics of the different types of social capital and the specific conditions of the different types of villages, the following countermeasures and suggestions for the sustainable livelihood of farmers and rural sustainable development in the mountainous area are proposed. These suggestions provide a guide for promoting the sustainable livelihood of farmers and for restructuring rural social capital and sustainable rural development in mountainous areas of China:

(1) The positive role of individual social capital, which is composed of traditional and extended social capital, on non-agricultural employment of farmers should be highlighted and the incomes of poor households should be increased. Extended social capital is acquired by the individual; therefore, the government should gradually improve human capital and promote social participation via the development of human resource measures such as labor skill training and education development. This would gradually help farmers in mountain areas to increase their extended social capital. In river valley villages, the

restoration of traditional social capital should be strengthened, and in semi-mountain villages, balanced development of the two types of individual social capital should be promoted.

(2) Local government departments should develop non-agricultural employment information to compensate for the limited and imperfect information in the cross-regional labor market. The positive role of the "guanxi" network in non-agricultural employment is essentially due to imperfect labor market information. Poor farmers are unable to invest in social capital, making it easier for them to fall into the vicious poverty cycle. Therefore, the government should provide non-agricultural employment information to farmers in high mountain and semi-mountain villages, especially poor households, to help them obtain non-agricultural employment. In addition, industries with comparative advantages should be developed based on local conditions; this would help rural laborers to achieve non-agricultural employment directly in mountainous areas.

(3) Strengthen the positive influence of rural collective social capital on the choice of agricultural livelihood strategy and both agricultural and rural development in mountainous areas. In high mountain and semi-mountain villages, under policy support and guidance from the government, agricultural resources could be more fully utilized. Based on the endowment of agricultural resources, farmers' cooperatives should be established and improved to promote agricultural specialization, modernization, and increased agricultural income. In river valley villages, the function of the PECO should be further optimized to promote a continuous increase in agricultural and farmers' incomes, so that agriculture can truly become a prominent industry in the countryside. Farmers' cooperatives in river valley villages should be encouraged to expand via merging and reorganization in order to further promote their role in agricultural and rural development in mountainous areas.

Acknowledgements

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