Impacts of Land Acquisition for Solar Farm on Farmers' Livelihoods in Viet Nam: A Case Study in Ninh Thuan Province, Vietnam

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Abstract

The objective of this research is impacts of Land Acquisition for solar farm on farmers' livelihoods in Viet Nam. It was carried out with a quantitative survey of 215 households whose land has been purchasedand for solar farms in NinhThuan. The exploratory factor analysis (EFA), the confirmatory factor analysis (CFA)and structure equation modeling (SEM) have been used to evaluate factors affecting people's livelihood satisfaction. Besides, the study also conducted in-depth interviews with managers of some solar power projects in NinhThuan; from there, propose some recommendations and suggestions to increase the efficiency of people's livelihood transformation. Research results show that farmers' livelihood in NinhThuanafter selling land is not secure for their live due to lack of land. They need to cooperate with solar farms and other entities to develop modern agricultural production activities under solar panels or rooftop model. Thereby ensuring a sustainable livelihood for them as well as the solar farm development.

Keywords*: livelihoods, solar farm, Land Acquisition, farmer*

1. Introduction

February 11, 2020,the Politburo has issued Resolution No. 55/NQ-TWon "Strategic orientations for Vietnam's national energy development to 2030, with a vision to 2045" set a target on renewable energy development that the share of renewable energy sources in the total primary energy supply will reach about 15% to 20% by 2030; 25% to 30% by 2045. To achieve this goal, this Resolution has oriented many key and synchronous tasks and solutions, which will "form and develop a number of renewable energy centers in regions and localities with advantages".

This is a breakthrough solution to be able to fully and effectively exploit renewable energy sources in areas rich in renewable energy resources (wind, solar) and have suitable land fund for exploitation and less competition with other land use needs.

NinhThuan province is planned to be a solar power center of the country; By the end of 2021, there have been 50 solar power farms andtheir total capacity is 3,120MW on a land area of 4,349ha. According to the Action Plan for the implementation of Resolution No. 55 of the NinhThuan Provincial Party Committee, by 2030, the total capacity of power sources will reach about 13,717MW, the output of electricity is likely to reach about 34.8 billion kWh. Particularly for solar power, the province is expected to develop 8,442 MW, which, when successfully implemented, will account for 42% of the total 20,050 MW of total installed solar capacity nationwide in 2030 according to the base scenario; with such an installed capacity, the needed land area is about 12,000ha (Doan & Bui, 2021). With a population density of 181 people per square kilometer, the estimated number of affected people is between 15 and 20 thousand people. This group of people are mainly Cham ethnic people, they have low and middle income, they mainly work in agriculture (cattle raising and farming) and use land as a main source of livelihood. Land sold for solar power projects is mainly productive forest land with suitable soil characteristics for raising sheep, goats, cows, or growing some drought-resistant trees.

According to Mr. Nguyen Quoc Viet, Director of SUNGLIM.TT SOLAR POWER COMPANY LIMITED: "The State and NinhThuan province have issued many policies to transform livelihoods, secure jobs, incomes and lives of people with landacquired by solar power project. However, the situation of underemployment, unemployment, and failure to change careers for this group has been happening in many places. This is due to the lack of land for livestock and farming, the money from the sale of land has not been properly used by households to change jobs and create new livelihoods that do not rely on land."

According to Pham et al., most of the money from land sales, farmers use to buy expensive durable assets such as cars and motorbikes, build houses, divide inheritance; or if you save, after nearly ten years, you will spend all that money. Only a small percentage of respondents invest this money to create a new livelihood that will help them switch careers and create a stable long-term income. This is a problem that many studies have pointed out on a national scale (Pham et al., 2021).

From the above fact, a problem arises that needs to change livelihoods for people in NinhThuan when developing solar farms. To solve this issue, the authors focus on studying the model of factors that form sustainable livelihood assets of people after selling the land. This study will open up strategic orientations for solar energy investors in supporting livelihood transformation for people who have lost their land, thereby solving labor and employment issues and ensuring the sustainable development of solar power projects and farmers.

2. Background of Study

2.1. Changes in farmers' livelihoods when selling forest and agriculture land

Land in Vietnam is owned by the entire people, the State is the representative for management, they construct land zoning and planning; they also allocate every kind land to users by granting of certificates of land use rights. With forest and agriculture sectors, all farmers have been granted the land use rights since 1960; they have the right to sell their forest and agriculture land to others (The Land Law 2013). Furthermore, forest and agriculture land have not been redistributed since 1993 – the first Land Law in Vietnam; so that people born after 1993 not being granted forest and agriculture land (Huong, 2014).

Vietnamese agricultural activitiesareprincipalrevenue sourcesof farmer and of the national economy.Rural areas account for 63% of the population, 66% of households, 68% of people working; agriculture accounts for 13.96% of GDP (GSO, 2019).Whileviewing many optimisticdevelopments in Vietnam, Agricultural activities in Vietnam have low added value compared to other countries in the region (Pham et al., 2021) andin addition, labor productivity in the agricultural sector is only equal to 38.9% of the these of the whole economy, only 30%in the industrysector and 33.7% in the service sector (Tung Đinh, 2020). Some main reasons why the labor productivity and added value of agriculture activitiesin Vietnamarevery lowcompared with others in Asia are due to the fragmented and small in production scale, low level of expertise and professionalism of farmers, and their physical condition are weak, labor in the fields is mainly the elderly and young children (Vien, 2020).

Agricultural activitiesrepresentedin household income changed from 28.6% in 2002 to 19.9% in 2012. Similarly, the share of basic agriculture income in rural households fell from 43.4% in 2002 to 31.8% in 2012, and has been exceeded by "wages and salaries" in 2010(World Bank, 2016). Farming is more and morereducing its position and importance in farmer livelihoods in rural area. Farmers' traditional livelihoods are based on agricultural production.So, many of them have the mentality of keeping land for self-defense, making the process of accumulation and concentration of agricultural land difficult and slow (Vien, 2020).

The fast development of renewable energy since the 2010sin Vietnam has directed to transformation of forest and agriculture land into the solar farms in big scale. Such conversions createmode for changing Vietnam's agriculture and livelihoods.The farmer has changed from cultivation (traditional activity with main crops such as rice, coffee, cashews, and pepper) to livestock farming with main animals such as poultry and cattle (pig, buffalo, cow, sheep, goat). Quantity of big scale livestock households are increasing. From 2006 to 2011, the farmers having over 50 pigs augmented by 80%, the figure of farmers having over 1000 poultry augmented by 4.32 times. Overall, nevertheless, the total number of breeding farmers declined by 35% and the farmers breeding one or two pigs at home still calculated for 50% of total in 2011 (Pham et al., 2021). Lately, the models of green, clean, climate-smart and biology agriculture have been

studied and introduced, targeting for sustainable agriculture future. This is the recently appeared tendency for farmers in Vietnam (Nguyen &Warr, 2020).

However, only limited farmers find out some kinds of stable non-agricultural jobs (such as taxi drivers, retailer, contractors, etc.). Many farmersinvolve into simple, part time works, which do not needworking skills andeducation, but with modest income.Severalresearch shows that various farmers without agricultural landthey lack jobs and particularly have not enoughworkto feed themselves when they sold their forest and agriculture land for the state's industrilization and urbanization. Some farmers feel that their livelihoods are more breakable, un-sustainable in contrast with the time they cultivatedon their land. After selling of forest agriculture land, they have to purchasedaily living goods; so they depend more and more on a stable monthly income as well as the market's supply of consumer products; this is different from their previous life(Suu, 2010).Moreover, they also have to face a lot of risks such as African Swine Fever and H5N1, leading to a sharp decrease of livestock (Ha Ngan, 2020).

According to the Asian Development Bank (ADB), farmers affected by land acquisition should be supported to improve their living standards, or at least restore their lives, to the old or higher life before they have their land acquired and relocated (ADB, 1998). According to the World Bank (WB, 2004), income restoration is an important part of land acquisition policy when the affected people lose their production, business, employment or other sources of income. In a broader sense, these policies not only guarantee income after land acquisition, but also ensure sustainable livelihoods for vulnerable people. Livelihood includes the capabilities, assets (including physical and social resources) and activities necessary to earn a living (DFID, 1999).According to the sustainable livelihood model, a policy on recompense and support for farmers whose land has been acquired creates a sustainable livelihood when it affects people's livelihood assets (people, human resources, material, financial and natural resources) and combined with changing livelihood methods (agricultural and non-agricultural) ensures augmented income for farmers after land acquisition.

2.2. Study Site

NinhThuan is a coastal province in the South Central Coast of Vietnam with an area of 3,355.34 km²; in which, hills and mountains account for 63.2% of the province's area, mainly low mountains, the average height is from 200 to 1,000 meters. The hilly and semi-mountainous areas account for 14.4% and the coastal plains account for 22.4% of the natural land area. NinhThuan has a tropical savanna to sub-desert climate with characteristics of hot, dry, windy, and strong evaporation (Wikipedia, 2022). NinhThuan is known as the land of sun and wind; These topographical and climatic features are very suitable for developing renewable energy such as solar power and wind power.

In 2018, NinhThuan is Vietnam's 58/63th largest administrative unit in terms of population, 57/63th in Gross Regional Domestic Product (GRDP), 45th/63rd in GRDP per capita. 10th in terms of GRDP growth. With 611.8 thousand people, GRDP reached 24,288 billion VND

(equivalent to 1.0549 billion USD), per capita GRDP reached 39.7 million VND (equivalent to 1,724 USD), GRDP growth rate reached 10.25% (Wikipedia, 2022). With the characteristics of a poor province, low population size, natural, social and human conditions are not suitable for modern industrial development. Therefore, NinhThuan was chosen to become the renewable energy center of Vietnam with the main pillars being solar power and wind power. Figure 1 below is a map of NinhThuan, the map on the left of the province's location is highlighted in red, the map on the right of the province's boundaries is darker.
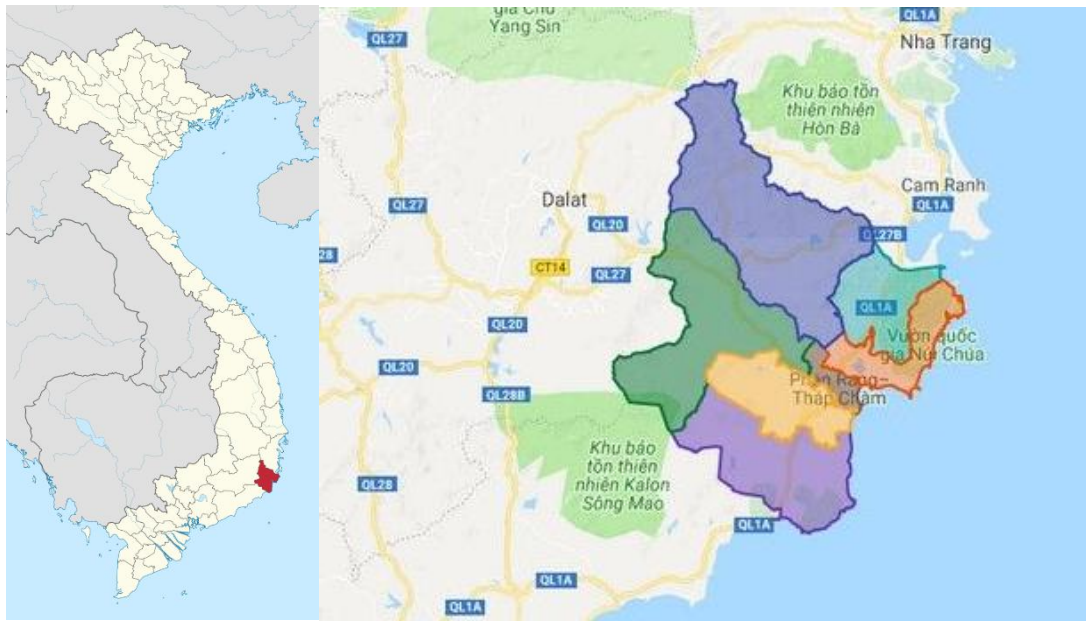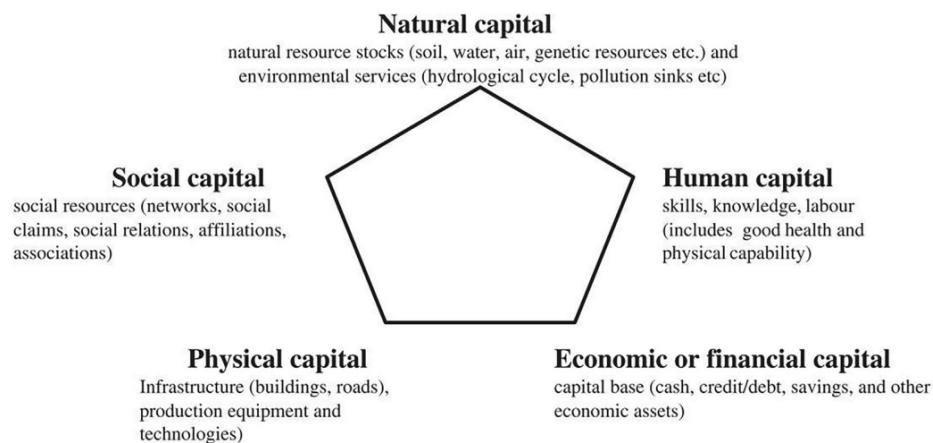

Figure 1. Map of NinhThuan

3. Research Methodology

3.1. Theory background

The livelihood concept can be used in diversecontext. Following the conceptofDFID: "A livelihood comprises the compatibilities, assets (including both material and social resources) and activities required for a means of living" (DFID,1999). Research of Hanstad and Carney confirm that asustainable livelihood existedwhen it coulddeal with and recover from shocks, stresses, and preserves or improve its capacities and assets both now and in the future, while not undermining the natural resources (Hanstad et al., 2004; Carney, 1998).

According to Morse et al., (2009), there are five types of capital that form a sustainable livelihoods as follows (figure 2): (1) Physical capital comprises the basic infrastructure and production equipment, technologies needed to support livelihoods; (2) Economic and financial capital represents the money sources (cash, credit, savings) and other economic assets that householdsneed to accomplish their livelihood purposes; (3) Social capital is social resources in which households use to pursue their livelihood objectives, comprises networks, social claims

and relations, associations, affiliations, mutuality, and conversation that offersignificantcasual networks; (4) Human capital denote knowledge,skills, labor,capability to work and good health that together enable farmers to achieve livelihood objectives and strategies. Human capital also existed on household level that is the factor of labor available (amount and quality); this depends on education and skill, household size,health, leadership potential, consciousness of formal and customary tenure structures (authority structures, procedures, rights, law, norms); and (5) Natural capital consist of all natural resource such as soil, water, air, etc., and environmental services from which households exploit these resources and useful services for sustainable livelihoods. There is a widespreaddifferencetypes of natural capital, but land resources are the main and traditional one for farmers.

Natural capital
natural resource stocks (soil, water, air, genetic resources etc.) and environmental services (hydrological cycle, pollution sinks etc)

Social capital
social resources (networks, social claims, social relations, affiliations, associations)

Human capital
skills, knowledge, labour (includes good health and physical capability)

Physical capital
Infrastructure (buildings, roads), production equipment and technologies)

Economic or financial capital
capital base (cash, credit/debt, savings, and other economic assets)

Figure 2. The five Capitals of Sustainable Livelihood (Morse et al., 2009)

The pentagon of five types of capital assets for sustainable livelihoods model is the theory that helps householdsformtheir capital, thereby reducing poverty and securing their livelihoods. Thistheory also knows that institutions, policies and processes effectcontact to and use of assets, thatfinally affects sustainable livelihoods (Paulo Filipe 2005). The foundation of sustainable livelihoods refines land resources as a central natural capital of rural household livelihoods andform a basic for farmers to access other livelihood options and capital resources (Hanstad et al., 2004).

Studies in Vietnam as well as abroad often suggest that land is recognized as the most valuable asset and a vital means to attain sustainable livelihoods and exist a direct relation between land access and livelihoods security (Suu, 2010).Thus, this study uses the five types of capital assets for sustainable livelihoods model to estimate the Impacts of land acquisition for solar farm on farmers' livelihoods in Vietnam.

3.2. Research Method and hypothesis

With the research objective of assessing the impact of selling forest land and agricultural land for solar power on the livelihoods of households in NinhThuan, this study will survey two subjects: solar power project managers and households selling land for solar power projects. For the first group, senior managers from solar power projects were interviewed using in-depth personal methods. With the second group, the authors conducted a quantitative study of five types of capital assets affecting the sustainable livelihoods of farmers. To build a questionnaire modeled on The five Capitals of Sustainable Livelihood, the authors also conducted a qualitative study (focus group method) with 7 farmers who sold land to a solar power plant in NinhThuan. The use of a combination of qualitative and quantitative methods is considered suitable for sociological studies in which a new scale needs to be developed, and moreover when the survey subjects are small in number (Creswell and Clark, 2007; Hitchcock, 2017).

The proposed research model includes five independent factors in the theoretical framework of The five Capitals of Sustainable Livelihood (Physical capital, Economic and financial capital, Social capital, Human capital and Natural capital) and an independent factor that is the householdlivelihoodsatisfaction. From this model five research hypotheses are proposed below.

- Hypothesis H1: Physical capital (PHCF) has a positive impact on the household livelihood satisfaction (LLSF).
- Hypothesis H2: Economic and financial capital (EFCF)has a positive impact on the household livelihood satisfaction (LLSF).
- Hypothesis H3: Social capital (SOCF) has a positive impact on the household livelihood satisfaction (LLSF).
- Hypothesis H4: Human capital (HUCF) has a positive impact on the household livelihood satisfaction (LLSF).
- Hypothesis H5: Natural capital (NACF) has a positive impact on the household livelihood satisfaction (LLSF).

3.3. Data Collection and analysis

For quantitative analysis, all of the questions in the model are a 5 point Likert scale. The scale for independent and dependent factors is designed as follows. (1) Physical capital factor includes 5 items: livestock technology, cultivation technology, equipment for livestock, equipment for cultivation and infrastructure in the area serving agriculture (roads, pumping stations, water, waste treatment, etc.). (2) Economic and financial capital factor includes 4 items: cash, savings, credit, gold and jewelry that can be mobilized for agricultural production. (3) Social capital factor consists of 4 items: networks, social relations, associations, affiliations. (4) Human capital factor includes 5 items: skills, knowledge, labor, health and physical capability. (5) Natural capital factor includes 5 items: arable land, livestock land, water source, environment, agricultural ecosystem. The scale for livelihoods satisfaction (dependent factor consists) of 4

items: satisfaction with crop livelihoods, satisfaction with livestock livelihoods, satisfaction with other livelihoods, current livelihoods are not equal to livelihoods before land and forest sale.

In addition, for each factor in the quantitative questionnaire, there is an open-ended question to collect more opinions about the respondents' aspirations. Qualitative research, 8 senior managers from 8 solar power projects were interviewed using in-depth personal methods on topics related to opportunities and challenges of cooperation between them and farmers in exploiting the land under the solar panels to serve livestock and farming activities.

This sample size has been designed in accordancewith Hair et al., (2010); in which, sample size must be greater than five times the number of research variables. So, with 27 variables in the model, the minimum sample size should be 135 respondents. To expand the representativeness, the surveyused a sample size of 215respondents.

The sampling method used is a convenience method. The research team selected 8 solar power projects in 3 districts of Thuan Bac, Thuan Nam and NinhPhuoc (these are the 3 districts with the most solar power projects out of 6 districts of NinhThuan province). Survey subjects were selected from households that have sold forest and agricultural land for these solar power projects.

The quantitative data analysis method used in this study is a combination of exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). The EFA method was used first because the research team developed a new set of questions based on The five Capitals of Sustainable Livelihood model. SPSS software version 22 and AMOS version 25 were used to analyze the obtained data.

4. Research results

4.1. Descriptive statistic results

Gender: 102 men (47%) and 113 women (53%).

Age: Age group of 40 to 50 (38%) representing the biggest percentage, following group is the age of over 50 (34%), the age group of under 40 accounting for 28%.

Qualifications: The group that graduated from secondary school accounted for the biggest percentage(47%) following is the group of high school graduates with 44%, the graduate and postgraduate grouprepresenting for 3%.

Ethnicity: Cham people account for the largest proportion with 62%, followed by Kinh people with 35%, the rest are ethnic minorities.

Average household income groups: Income <12 million VND (500 USD) representing the biggest percentage (38%), followed byincome from12 to 24 million VND (500-1000 USD) accounting for 33%, Income group of > 24 million VND (1000 USD) accounting for 29%.

Main occupation of the household: Agriculture accounts for the largest proportion with 37%, traders in markets account for 23%, masons and carpenters account for 13%, home shop owners accounted for 11%, taxi drivers accounted for 9%, other occupations account for 7%.

Looking at the assets of households, it is found that most of them have permanent houses, televisions, refrigerators, motorbikes, washing machines and other essential appliances. These properties are formed from the sale of land for solar power projects. Figure 3 below shows the houses of the surveyed Cham villages.

Figure 3. The houses of the surveyed Cham villages

4.2. General research model Testing

Exploratory factor analysis (EFA)

The research model includes 1 dependent factor (4 variables) and 5 independent factors (23 variables); results of exploratory factor analysis (EFA) with Principle Component extraction, using Varimax rotation, using KMO (Kaiser-Meyer- Olkin) and Bartlett test methods to measure the compatibility as below.

Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) = 0.708, Sig. (Bartlett's Test) = $0.000 < 0.05$. Rotation Sums of Squared Loadings (Cumulative %) = 68.67% > 50%. This proves that 68.67%% of the variation of the data (23 independent variable) is explained by 5 factors. Cronbach's Alpha analysis show that all scales have coefficient greater than 0.7 and total variable correlation coefficient greater than 0.3. Thus, 23 independent variable used have enough

reliability for the following analysis. Table 1 below shows 23 independent variables forming 5 factors with Factor Loading of all variables having values greater than 0.6. These results are consistent with the test standards of Hair et al., (2010).

Table 1. Rotated Component Matrix[a]

	Component				
	1	2	3	4	5
PHC1				0.733	
PHC2				0.752	
PHC3				0.675	
PHC4				0.833	
PHC5				0.681	
NAC1	0.767				
NAC2	0.771				
NAC3	0.669				
NAC4	0.715				
NAC5	0.812				
SOC1		0.848			
SOC2		0.739			
SOC3		0.868			
SOC4		0.845			
EFC1					0.781
EFC2					0.683
EFC3					0.914
EFC4					0.855
HUC1			0.725		
HUC2			0.718		
HUC3			0.626		
HUC4			0.711		
HUC5			0.698		

Confirmatory factor analysis (CFA)

To evaluate the overall fit of the structural model, the authors use the following criteria: Chi square (CMIN); Chi Square adjusted to degrees of freedom (CMIN/degree of freedom); Goodness of Fit Index (GFI); TLI (Tucker & Lewis Index); Comparative Fit Index (CFI); RMSEA (Root Mean Square Error Approximation) index. The structural model is appropriate when the Chi Square test result has a P>0.05 value. Though, Chi Square has the drawback that it be subject to on the sample size. The larger the sample size, the larger the Chi Square, thusdropping the fit of thestructural model. So, in addition P - Value, the criteria used are CMIN/degree of freedom, in some casesresearchers distinguish two situations: CMIN/degree of freedom< 5 (With sample N>200); or < 3 (When sample size N < 200), the model is considered

suitable (Kettinger and Lee, 1995).Because the sample size in this research is 215 > 200, the authors will use the criteria of Kettinger and Lee (1995) that accept CMIN/degree of freedom< 5; GFI, TLI, CFI > 0.9; RMSEA < 0.08, RMSEA < 0.5 is considered very good.
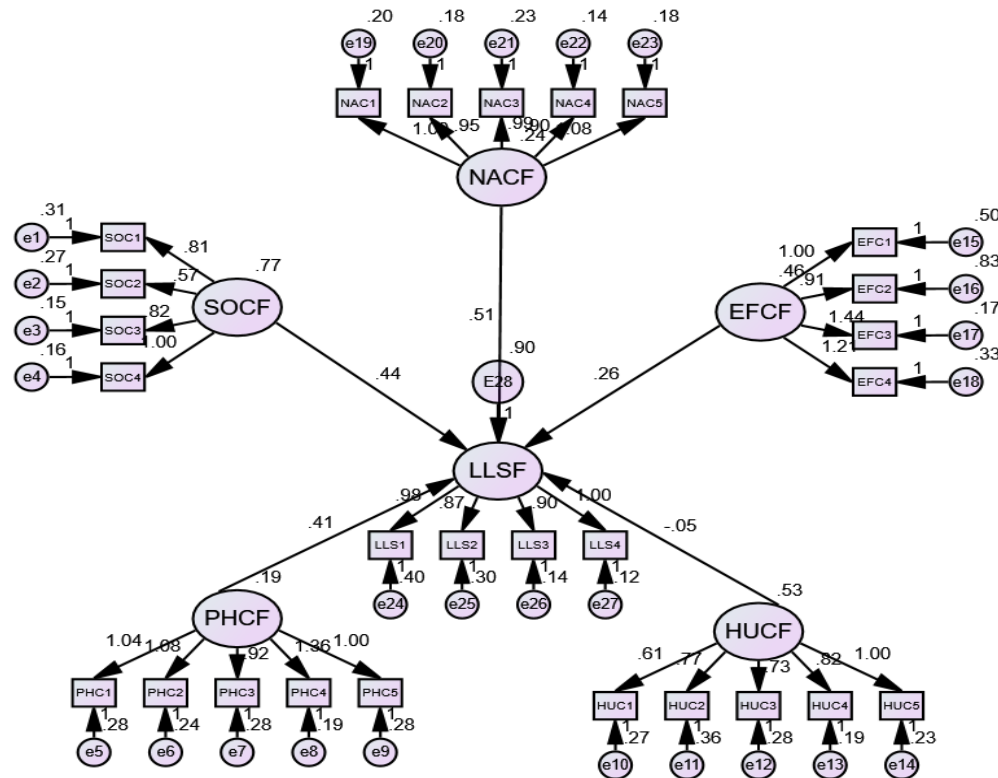
Figure 4. SEM result of the research model

The results of the confirmatory factor analysis test on the fit of the research model are: Chi-Square/degree of freedom = 4.718; GFI = 0.913; CFI = 0.907, TLI = 0.903, RMSEA=0.079. Squared Multiple Correlations of LLSF is 0.56; It is estimated that the predictors of LLSF explain 56 percent of its variance. This result shows that the model is fullyreliable with the survey data. Analysis of the SEM linear structure model found the test results in Table 2.

Table 2. Structure equation modeling coefficients

			Regression Weights Estimates	S.E	C.R	P	Hypothesis conclusion
LLSF	<---	NACF	.514	.154	3.339	***	H4 accepted
LLSF	<---	SOCF	.439	.082	5.358	***	H3 accepted
LLSF	<---	EFCF	.255	.107	2.391	.017	H2 accepted

			Regression Weights Estimates	S.E	C.R	P	Hypothesis conclusion
LLSF	<---	PHCF	.411	.172	2.385	.017	H1 accepted
LLSF	<---	HUCF	-.049	.100	-.494	.621	H5 rejected

*P: significance level; *** = p <0.001*

Structure modeling coefficients (table 2) indicates that hypotheses H1, H2, H3, H4 are accepted; in which hypothesis H4 has the highest Regression Weights (0.514) followed by hypothesis H3 and H1 with Regression Weights of 0.439 and 0.411 respectively; Hypothesis H2 has the lowest Regression Weights at 0.255; Only hypothesis H5 was rejected with the coefficient P=0.621>5%. Thus, it can be concluded that 4 factors (Natural capital, Social capital, Physical capital, Economic and financial capital) have an impact on the household livelihood satisfaction. The only human capital factor is not affecting the household livelihood satisfaction.

4.3. Qualitative report

Qualitative research results for 8 senior managers of 8 solar power projects on the topic of opportunities and challenges to cooperate with farmers to exploit land under solar panels of solar power projects in NinhThuan showed a high consensus on the following topics.

Opportunity. Managers have found that the land under the solar panels is currently unexploited for any purpose and this is a waste of land resources. The managers all believe that it is possible to cooperate with partners to implement planting and breeding activities on this land. However, with current solar power projects, the exploitation height is about 1.2 meters. With this height, it is only allowed to grow some plants with low height or raise some livestock such as sheep and goats. With future solar power projects, businesses can pre-design the exploitation height greater than 1.2 meters according to specific needs to grow a certain type of tree or raise a certain type of cattle and poultry such as: buffalo, cow, goat, sheep, chicken, etc. In addition, solar power projects can also be designed as solar rooftop; under there, the livestock, poultry such as pigs, chickens, cowsraised industrially with a large quantity. Some others proposed to build a wind power tower on the top, install solar power below and the bottom for agriculture. Figure 5 below is the solar farm and the rooftop solar farm.

Challenges. Managers say that the biggest challenge is choosing a partner to exploit land under solar. For the current solar power projects (the exploitation height is about 1.2 meters) the main concern is that agricultural activities adversely affect the electricity production of the solar farm. The risks involved are crops, livestock, farmers damaging solar panels. They also do not trust the qualifications and expertise of Cham farmers as partners. However, they can hire these farmers to do farming under the management of a solar power project. For future solar power projects, they are willing to cooperate with farmers to exploit a combination of solar power and agriculture. This form will help businesses not have to buy forest land, agricultural land but only need to pay rent. This reduces the total investment capital, shortening the payback period. But

this needs a clear legal framework to protect the interests of the parties. The rooftop solar model with agricultural farms is said to be very suitable because they can apply modern science and technology to agriculture and sell solar power to these farms.

Figure 5. The solar farm and the rooftop solar farm.

5. Discussion and recommendations

Discussion

The results of quantitative research for farmers can be summarized as follows. Before the solar power project, the livelihoods of households mainly relied on grazing sheep, goats, and cows on production forest land and planting some agricultural crops. With a low education level, most of them are Cham ethnic people living in remote areas, their living standards are lower than other

areas in NinhThuan. After selling production forest land for solar power projects, households earn a large amount of money. They built a new house, bought many items with money; others have converted their livelihoods towards service or trade. Up to now (2022) after 4 years of selling land, many households have no land to pursue their old livelihood (grazing cattle), their savings are also running out and they have to face a lack of jobs and agricultural production land. Research data shows that the factor that has the strongest impact on their livelihood satisfaction is the natural capital factor, which is mainly a lack of livestock and farming land. The next factor that strongly influences livelihood satisfaction is social capital; these farmers (more than 50% are ethnic Cham) are aware that their livelihood depends on networks, social relations, associations, affiliations; However, due to the fact that they are ethnic minorities and live in remote areas, their social capital is still weak and has not yet provided them with a livelihood. The third important factor is physical capital, theyrealize that technology, techniques and equipment used in farming and livestock raising also affect their livelihood satisfaction. The fourth important factor is economic and financial capital, households can only sell land for solar power projects, so this factor is considered less important to them. The fifth factor human capital (skills, knowledge, labor, health and physical capability) is found to be unimportant with livelihood satisfaction. This can be explained as they are confident about their labor, health and physical capability, skills, knowledge. This can be an obstacle in working with solar farms as the biggest concern for managers is the qualifications and expertise of Cham farmers as partners.

Research results show that farmers and solar farms have a need to cooperate with each other in the present as well as in future projects. However, there are many limitations from both sides that prevent the current cooperation such as the risks of growing crops and grazing animals under solar panels, the qualifications and expertise of Cham farmers, desires, motives and awareness of both sides in agricultural production, technical issues of cultivation and husbandry in narrow and low space (1.2 meter height of solar panel) etc. For solar farm projects in the future, the cooperation needs of both parties are urgent because the land fund for solar farm gradually decreases, land prices increase, farmers fear unemployment after selling land. However, in order to accelerate this process, the education level, awareness and ability to apply modern technology and techniques in agricultural production of ethnic minorities may be the biggest obstacle. The next content will cover recommendations to overcome these obstacles.

Recommendations

Existing solar farms open up opportunities for farmers in the region to continue pursuing agricultural livelihoods in two directions. The first is to become an agricultural worker (planting trees or raising livestock such as sheep and goats in solar farms). This job does not require farmers to have natural, physic, social, economic and financial capital; they just need human capital. Specifically, they need to be professionally trained to grow some drought-resistant crops or raise sheep and goats under solar panels in conditions that do not damage or disrupt the electricity generation of solar farms. The second is that farmers can rent land under solar panels for agricultural production (planting trees or raising livestock in solar farms). This is

unprecedented and solar farm managers do not yet trust farmers; They are concerned about the risk of damage to the equipment of the solar farm when farmers work under the solar panels. To solve this problem, farmers need to demonstrate their competence in natural, physic, social, economic and financial capital, especially human capital by demonstrating that they have sufficient knowledge, skills and techniques. , management ability in agricultural production in this condition. Solar farms also need to be aware that cooperating with farmers in addition to earning land rent also creates a sustainable livelihood for farmers, opening up opportunities to cooperate with them in solar power projects in the future and contribute to economic and social development in the region.

Future solar power projects in NinhThuan increasingly require cooperation between investors and farmers to ensure the symbiosis and sustainable development of both partners. In which the investor can reduce the cost of land (renting land instead of buying from farmers); Farmers can still continue to produce agriculture under solar panels or they develop a modern farm like solar rooftop. With this model, farmers are required to become large-scale agricultural investors, applying modern science and technology in planting and breeding, which uses part of electricity from the solar farm. This model needs to converge all 5 sustainable livelihood factors (natural, physic, social, human capital, economic and financial capital); In fact, very few farmers (especially in the solar power development areas in NinhThuan) can gather enough resources to do the project. Therefore, it is necessary to have many models of sharing and cooperation to develop farm agriculture combined with rooftop solar such as linkages between farmers and solar farm projects, linkages between farmers, and linkages between farmers and agricultural production enterprises, linking farmers with supermarkets and distributors of agricultural products. This association helps to share resources on natural, physic, social, human capital, economic and financial capital thereby ensuring the sustainable development of the parties.

The central government and NinhThuan also need to play an active role in promoting farmers' cooperation with other actors to ensure sustainable development in the region; ensure sustainable livelihoods for farmers as well as the development of businesses, thereby promoting economic development, social and welfare of the province. Therefore, it is necessary to develop a detailed plan for solar power development in Vietnam, to build a clear and transparent legal framework for solar power; in which it is necessary to encourage the sharing of land resources, encourage the combination of solar power with agriculture, encourage sharing and cooperation in the supply chain of agricultural products, and encourage the application of modern technology in agriculture. It can be concluded that sharing and cooperation is the main basis for ensuring sustainable livelihoods for farmers and the development of solar power in Vietnam.

Reference

1. Asian Development Bank (ADB) (1998).*Handbook on Resettlement*, Accessed July13, 2022 from: https://www.adb.org/sites/default/files/institutional-document/32259/handbook-resettlement.pdf

2. Creswell J. W. and Clark V. L. P.(2007).*Designing and Conducting Mixed Methods Research*. Aust. N. Z. J. Public Health 2007, 31, 388. [CrossRef]

3. Department for International Development-DFID (2007). *Land: Better access and secure rights for poor people* (2007);accessed on 10 July 2022at Land: Better access and secure rights for poor people - Mokoro

4. Department for International Development-DFID (1999), *Sustainable Livelihoods Guidance Sheets*.Accessed July13, 2022 from: https://www.ennonline.net/dfidsustainableliving

5. Diana Carney (1998). *Sustainable rural livelihoods*. Nottingham: Russell Press Ltd, 1998.

6. ĐoànVănBình&BùiVănHuyền (2021), PháttriểnTrungtâmnănglượngtáitạotỉnhNinhThuận; https://www.tapchicongsan.org.vn/web/guest/thuc-tien-kinh-nghiem1/-/2018/821654/phat-trien-trung-tam-nang-luong-tai-tao-tinh-ninh-thuan.aspx

7. GOS-Tổngcụcthốngkê (2019). *Niêngiámthốngkê 2019*. NhàxuấtbảnThốngkê, HàNội.

8. Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2010). *Multivariate data analysis* (7th Edition). Pearson Prentice Hall.

9. Hitchcock, J.H. (2017). *An Introduction to Mixed Methods Research*.; SAGE Thousand: Oaks, CA, USA, 2017; ISBN 978-1-4739-9171-2.

10. Ha Ngan. (2020).*Năm "BảnLề" Cho NgànhChănNuôiPhátTriển*. Available online: https://antvietnam.com/2020-nam-ban-lecho-nganh-chan-nuoi-phat-trien/ (accessed on 10 July 2022).

11. Hanstad, T., Nielsen, R., and Brown, T. (2004).*Land and Livelihoods – Making Land Rights Real for India's Ruural Poor*. Rural Development Institute (RDI)

12. Huong, N.L. (2014) Rijksuniversiteit Groningen; *Farmers' Land Tenure Security in Vietnam and China: Legislative Changes and Challenges.* Ph.D. Thesis, The University of Groningen, Groningen, The Netherlands, 2014.

13. Morse, S., McNamara, N.,Acholo, M. (2009). *Sustainable livelihood approach: A critical analysis of theory and practice*. Geographical Paper 189;accessed on 10 July 2022.[PDF] Sustainable Livelihood Approach : A critical analysis of theory and practice | Semantic Scholar

14. Nguyen, H.Q.; Warr, P. (2020). *Land Consolidation as Technical Change: Economic Impacts in Rural Vietnam.* World Dev. 2020, 127, 104750. [CrossRef]

15. OECD. Agricultural Policies in Viet Nam (2015). *OECD Food and Agricultural Reviews*; OECD: Paris, France, 2015; ISBN 978-92-64- 23514-4.

16. Paulo Filipe (2005). *The right to land a livelihood: The dynamics of land tenure systems in Conda, Amboim and Sumbe municipalities*. Norwegian People's Aid, 2005.

17. Pham Thi, N.; Kappas, M.; Faust, H (2021). *Impacts of Agricultural Land Acquisition for Urbanization on Agricultural Activities of Affected Households: A Case Study in Huong Thuy Town, ThuaThien Hue Province, Vietnam*. Sustainability 2021, 13, 8559. https://doi.org/10.3390/ su13158559

18. Philip F. Kelly (2003). *Urbanization and the politics of land in the Manila region*. Annals of the American Academy of Political and Social Science, Vol. 590, Rethingking Sustainable Development, 2003, pp. 170-187.

19. Politburo's Resolution 55-NQ/TW on the Orientation of the Viet Nam's National Energy Development Strategy to 2030 and outlook to 2045; accessed on 10 July 2022 at https://vepg.vn/legal_doc/cpv-resolution-on-the-orientation-of-the-viet-nams-national-energy-development-strategy-to-2030-and-outlook-to-2045/

20. Suu Nguyen Van (2010). *TácđộngcủacôngnghiệphóavàđôthịhóađếnsinhkếnôngdânViệt Nam: TrườnghợpmộtlàngvenđôHàNội*. NhàxuấtbảnĐạihọcQuốcgiaHàNội.

21. TùngĐinh (2020). *Ngànhnôngnghiệpchắcchắnxuấtkhẩuđạttrên 40 tỷ USD BáoNôngnghiệpViệt Nam*; BáoNôngnghiệpViệt Nam, ngày 06/10/2020.

22. Vien, T.D. (2020).*NôngNghiệpViệt Nam: NhữngVấnĐềTồnTại (The Gaps in Vietnamese Agriculture)*. 2020. Available online: https://tiasang.com.vn/-quan-ly-khoa-hoc/Nong-nghiep-Viet-Nam-Nhung-van-de-ton-tai-26635 (accessed on 9 July 2022)

23. Vietnamese Government (2013). *LuậtĐấtĐai 2013 (The Land Law 2013);* Vietnamese Government: Hanoi, Vietnam, 2014.

24. Vietnam Government (2016). *BáoCáoQuốc Gia VềKếHoạchSửDụngĐấtĐaiĐếnNăm 2020 VàKếHoạchSửDụngĐấtGiaiĐoạn 2016–2020 (National Report Land Use Planning up to 2020 and Planing Land Use for Peroid 2016–2020)*; Vietnam Government: Ha Noi, Vietnam, 2016.

25. World Bank (2016). *Transforming Vietnamese Agriculture: Gaining More from Less; Vietnam Development Report*; World Bank: Washington, DC, USA, 2016.

26. World Bank(2004). *Involuntary Resettlement Sourcebook: Planning and Implementation in Development Projects*. Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/14914 License: CC BY 3.0 IGO.

27. York, A.M.; Shrestha, M.; Boone, C.G.; Zhang, S.; Harrington, J.A.; Prebyl, T.J.; Swann, A.; Agar, M.; Antolin, M.F.; Nolen, B.; et al (2011). *Land Fragmentation under Rapid Urbanization: A Cross-Site Analysis of Southwestern Cities*. Urban Ecosyst. 2011, 14, 429–455. [CrossRef]