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Juheon Lee,
Midwestern State University, United States

*CORRESPONDENCE
Juan Yao,
409454654@qq.com

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A study on livelihood capital, social adaptation, and life satisfaction—empirical analysis based on ecological migration in the Kalajun world natural heritage site

Jiran Hu[1], Juan Yao[1]* and Changjiang Xiong[2]

[1]School of Economics and Management, Xinjiang Agricultural University, Urumqi, China, [2]Institute of Finance and Economics, Shanghai University of Finance and Economics, Shanghai, China

Improving the life satisfaction of ecological migrants is important for promoting the construction of an ecological civilisation. Based on using sustainable livelihood theory and social adaptation theory to construct an analytical framework for life satisfaction, we innovatively include livelihood capital, social adaptation, and life satisfaction in the same research framework. Using microscopic research data on Kazakh herders in Kalajun, Xinjiang, we empirically analyse the effects of livelihood capital and social adaptation on herders' life satisfaction using structural equation modelling and further discuss the direct and indirect effects of livelihood capital on life satisfaction. The results show that, first, the mean value of livelihood capital of the sample herding households is below the medium level overall, the mean value of social adaptation is above the medium level, and the life satisfaction of herders is above the medium level. Thus, the ecological migration policy has enhanced the herders' life satisfaction to a certain extent. Second, financial and natural capital contribute more to the level of livelihood capital, while cultural, life, and psychological adaptation contribute more to the level of social adaptation. Third, both livelihood capital and social adaptation have a significant positive effect on pastoralists' life satisfaction, i.e., the higher the level of livelihood capital and social adaptation of pastoralists, the more prominent their livelihood capacity and social relations are, and the higher their life satisfaction will be. Fourth, the direct effect of social adaptation on life satisfaction is significantly greater than that of livelihood capital; this should be used to alleviate psychological stress by enhancing herders' social adaptation abilities. Fifth, the direct impact of livelihood capital on life satisfaction is greater than its indirect impact, and the improvement in human and financial capital will help herders overcome their current livelihood difficulties. The findings of this study will help the government understand the level of livelihood capital and social adaptation of ecological migrant households and provide a reference for further improving ecological migrants' wellbeing and promoting sustainable regional development.

KEYWORDS

livelihood capital, life satisfaction, social adaptation, ecological migration, Kalajun world natural heritage site

1 Introduction

Ecological civilisation is a millennium-old plan for the sustainable development of the Chinese nation, and ecological migration plays a pivotal role in promoting ecological civilisation. Ecological migration refers to the process of relocating people whose livelihoods are limited by the deterioration of their living environments from their original homes (Essam, 1985). This process can reduce the continuous damage to the ecological environment caused by human activities and restore the ecosystem functions of relocated areas (Morrissey, 2013). However, the implementation of ecological migration policies involves not only the physical relocation of migrants, but also the resettlement of their spiritual places of belonging (Tan, 2019). The social adaptation of migrants is a long-term, complex, and multifaceted process that is influenced by a variety of factors. The lifestyle, cultural practices, and social relations inherent in the migrant community will evolve in response to factors such as infrastructure, income growth, and neighbourhood relations, leading to the integration and reconstruction of living spaces (Zhao et al., 2022).

"Life satisfaction" is a stable and comprehensive evaluation of people's living environment and psychological state over a certain period of time, emphasising the interaction between the external environment and psychological feelings about life. Therefore, in the context of the rapid advancement of ecological civilisation in the new era of China, the life satisfaction of ecological migrants, whose livelihoods are relatively fragile, deserves special attention. As an important part of the Tianshan Mountains in Xinjiang, China, the Kalajun Mountains were included on the *World Natural Heritage List* in June 2013. In response to the ecological problems of grassland degradation, declining vegetation cover, and land desertification in the development of Kalajun (Hu et al., 2018), the Xinjiang Tekes County government has implemented a top-down ecological migration policy for the Kalajun World Natural Heritage Site since 2013, based on the principle of "herding as appropriate, business as appropriate, and tourism as appropriate" (Hu et al., 2020).

The implementation of the Kalajun Ecological Migration Policy caused indigenous people to leave their homes and move to resettlement areas to start new lifestyles. The traditional methods of production and the life of Kazakh herders have thus undergone radical changes. In particular, the contradiction between the transition of Kazakh herders' livelihoods and ecological protection has become increasingly evident (Hu et al., 2019). This process is inevitably accompanied by problems in the adaptation of migrant families to production methods, lifestyles, social network relations, rural customs, and other aspects. It is thus worth asking questions such as have the practical problems faced by migrant families been solved today? How have they adapted to post-settlement production methods, lifestyles, customs, and interpersonal relationships? How satisfied are migrants with their lives?

This study uses first-hand data from fieldwork in Kalajun and combines the sustainable livelihood and social adaptation theories to build a theoretical framework for life satisfaction analysis. This study innovatively places livelihood capital, social adaptation, and life satisfaction in the same research framework to reveal their relationship. Structural equation modelling is also used to empirically analyse the effects of livelihood capital and social adaptation on life satisfaction. This approach can further verify the direct and indirect effects of livelihood capital on life satisfaction, which has important theoretical and practical implications. On one hand, including livelihood capital and social adaptation in the same research framework is a useful approach. Using this framework to study life satisfaction, especially for ecological migrants, can provide an important theoretical guide for the future exploration of life satisfaction among similar livelihood-vulnerable migrant groups in developing countries. On the other hand, the selection of grassland pastoral areas in World Natural Heritage sites to conduct research on the life satisfaction of ecological migrants will help better translate the policy advantages of ecological migration to improve the life satisfaction of migrants in remote pastoral areas. This can promote the construction of a rich border and ecological civilisation and demonstrate the effect of ecological migrant resettlement areas. This is conducive to providing a scientific reference for improving the wellbeing of residents in the ecological protection areas of World Natural Heritage Sites.

2 Theoretical analysis and research hypothesis

2.1 Impact of livelihood capital on life satisfaction

The Sustainable Livelihood Framework developed by the UK Department for International Development in 2000 (DFID, 2000) is widely used in livelihood research. This framework comprises five components: vulnerability, livelihood assets, policy regimes, livelihood strategies, and livelihood outcomes. These components interact in complex ways to identify and exploit opportunities through the combination and application of different livelihood capital to shift livelihood strategies in the pursuit of livelihood security (Soini, 2005). As a core element of the sustainable livelihood framework, livelihood capital is critical for achieving sustainable livelihoods (Li et al., 2014). The interconversion between human, physical, natural, financial, and social capital can be effective in hedging livelihood risks and improving livelihood outcomes (Ellis, 2003). The flow of energy between various types of capital is pyramidal, with financial capital at the highest level (Callaghan et al., 2008). Livelihood capital is the most important factor influencing the livelihood transition of a population and determines the efficiency of the livelihood transition (Zhong et al., 2022). Sustainable livelihoods are characterised by security, adaptation to stress, and income diversification (Chambers et al., 1992).

Human capital, dominated by the amount of labour in pastoralist households, influences the choice of household livelihood strategies (Sun et al., 2018). A sufficient number of labourers is conducive to increasing the diversity of the income structure of pastoralist households, thus enhancing income stability and contributing to the satisfaction of pastoralists.

Physical capital exists over time in the form of productive goods. For pastoralist households, physical capital is mainly the infrastructure and means of production needed to sustain their

livelihood. Examples include livestock, machinery, equipment, buildings, and transportation facilities.

Physical capital has a positive impact on the income of pastoralist households, which in turn affects life satisfaction (Hu et al., 2018).

Natural capital provides natural resources and environmental services for household livelihoods (Su et al., 2009). The size and quality of pastures are the most tangible expressions of natural resources in herding households in Xinjiang's pastoral areas. These factors affect the scale of livestock breeding in herding households. The larger the livestock production operation, the higher the operational inputs, the greater the likelihood of high returns, and the higher the life satisfaction of the herders will be.

Financial capital is mainly expressed in the income savings of pastoralist households. This is the driving force behind the functioning of pastoralist livelihood systems (Dong et al., 2020). Financial capital reflects the resilience of pastoralist households; in general, the more resilient they are, the higher their life satisfaction will be.

Social capital is an asset expressed in terms of access to networks, trusting relationships, solidarity, norms, rules, and sanctions, political participation, and cooperation (Grootaert et al., 2004). It is considered to be a catalyst for increasing economic opportunities (Fitzpatrick et al., 2020). Social capital is classified into bridging and bonding social capital (Putnam, 2020). Social capital provides pastoralists with social networks and organisational relationships that can be used in their livelihood activities. Social capital is mainly reflected in the mutual trust between pastoralists, the participation of individual farmers in organised groups, and the interconnection and assistance between family and friends. Social capital is also an important source of life satisfaction for pastoralists (Lin et al., 2019).

National and international research has found that livelihood capital is inextricably linked to satisfaction with life and the living environment.

On one hand, natural, human, social, and physical capital are significantly and positively related to life satisfaction (Liu et al., 2018). The higher the neighbourhood attachment and social cohesion, the less loneliness will be experienced (Habib et al., 2020). Thus, it is clear that increasing and improving the structure of livelihood capital positively and indirectly affects residents' life satisfaction (Li et al., 2022). Hoogerbrugge et al. (2018) also suggested that an increase in social capital will help increase life satisfaction. Dirzyte et al. (2022) suggested that an increase in psychological capital will increase the life satisfaction of residents.

On the other hand, Cai et al. (2015) argued that increased physical capital in the form of land rentals, hired labour, etc. will reduce the life satisfaction of farm households. Wang et al. (2017) noted that a lack of natural capital, an aging population, and a surplus labour force lacking skills can reduce the life satisfaction of pastoralist households. The living environment, which consists of elements such as the climate, natural landscape, public services, and transport facilities, together with housing conditions and amenities, positively influences life satisfaction (Dang et al., 2021). The living environment is a major factor influencing the overall satisfaction ratings of residents (Kang et al., 2022). The natural living environment is the most significant factor affecting satisfaction with rural habitat improvement (Gui et al., 2021). Kley et al. (2021) concluded that having various forms of green space will increase the life satisfaction of residents, and urban residents are significantly more satisfied with their living environment than rural residents. Thus, it is evident that factors such as livelihood capital have a heterogeneous influence on the extent and direction of satisfaction with living and residential environments (Lu et al., 2021).

Livelihood capital is representative of the standard of living in pastoralist households to some extent, and satisfaction can be used as a subjective assessment of livelihood outcomes. Therefore, it is feasible to explore the impact of livelihood capital on pastoralist life satisfaction. The level of livelihood capital affects the evaluation of pastoralists' life satisfaction. The life satisfaction of ecological migrants is a subjective evaluation of their quality of life and living environment after the implementation of the ecological migration policy, based on the herders' own criteria. Differences in livelihood capital among pastoralists are an important factor in their differing satisfaction ratings. This study examines five aspects of livelihood capital and assumes that the higher the level of livelihood capital, the richer the pastoralist's livelihood. Thus, we propose hypothesis H1.

H1: The higher the level of livelihood capital, the higher the life satisfaction of ecological migrants.

2.2 Impact of social adaptation on life satisfaction

The concept of "social adaptation" was first introduced by Herbert (2012). He considered social adaptation to be the process by which individuals gradually adapt to their social environment and adjust their behaviour. According to Feng (2014), social adaptation involves a series of psychological and behavioural changes and their outcomes that result from individuals achieving harmonious relationships with their external environment. This concept is often used to study the interactions between migrant individuals and the social environment.

Ecological migration is not only a process of re-adaptation to a new production and living environment. It is also the result of herders' adaptation to their current production and living conditions through the adaptation of their own psychology and behaviour. However, changes in living and productive spaces can easily lead to difficulties in social adaptation for migrants, which can reduce their feeling of wellbeing (Chen et al., 2019). Therefore, based on the research of scholars and the actual situation of migrants at heritage sites, this study summarises the social adaptation of ecological migrants through five aspects: production adaptation, life adaptation, cultural adaptation, psychological adaptation, and interpersonal adaptation (Wang et al., 2020).

Productive adaptation refers to the adaptation of pastoralists to new production methods after migration. Before migration, pastoralists used pastures for traditional grazing livelihoods and livestock-related labour. After migration, the area of suitable pastures for herders is limited and the use of grass for livestock leads to a reduction in the number of livestock raised by herders. As a result, the herders change from a solely herding-based livelihood to more diversified livelihoods, such as tourism, working outside the

home, and livestock farming. The adaptation of pastoralists to post-migration production methods is linked to the stability of their families and affects their life satisfaction.

Living adaptation refers to the adaptation of pastoralists to a settled life after migration. Before migration, the herders lived a nomadic life of burning cow dung for heating, using horses for walking, drinking well water, and having poor communication. After migration, the herders are housed in government-built resettlement houses, where water, electricity, communications, transportation, and other infrastructure are available, and smooth logistics facilitate online shopping. Thus, there is a correlation between lifestyle adaptation and pastoralist life satisfaction.

Cultural adaptation refers to the adaptation of pastoralists to the "new folkways and customs" of the settlers. It is a reflection of the herders' inheritance of traditional pre-settlement customs and traditions. Because of the need to integrate and reconfigure social and cultural spaces, traditional cultural practices are recreated and reconstructed in new environments. Thus, the adaptation of the transmission of folklore influences the life satisfaction of migrants.

Psychological adaptation describes the psychological adaptation of migrants to new ways of production and life. Migration involves not only a change in geographical location but also a shift in production methods, social relations, and culture. The original pastoralist livelihoods and their nomadic cultures are impacted, and new livelihoods require developing cultural practices adapted to the new environment. In this regard, immigrants' psychological states can fluctuate and become prone to anxiety as they cope with changing cultural practices in their new environment. According to Zhang (2022), psychological adaptation refers to psychological wellbeing and life satisfaction in cross-cultural encounters based on emotional responses.

William (2005) argues that "psychological adaptation" is achieved if pastoralists have no or less negative emotions such as depression, anxiety, loneliness and disappointment after migration. Therefore, the better the migrants' psychological adaptation, the higher their life satisfaction will be.

Interpersonal adaptation is the attempt by migrants to achieve a harmonious relationship with their settled environment. Migrants need to adapt psychologically and behaviourally to better integrate into their living environment. Before migration, interpersonal relations among pastoralists were relatively stable, with neighbours knowing each other well and often helping each other. After migration, neighbours in the settlements of pastoralists are located close to each other but the residents are not yet acquainted. The interpersonal relationships of people in settlements remain relatively independent and thus a long period of adaptation is required to achieve harmonious and stable interpersonal relationships. Interpersonal adaptation is closely related to the life satisfaction of migrants.

Social adaptation of ecological migrants is a matter of livelihood and wellbeing (Wu, 2017). Only when pastoralists adapt to new ways of production and life in the resettlement area can they develop a sense of belonging. Hong (2014) confirmed that the social adaptation process of ecological migrants in pastoral grassland areas ultimately affects their life satisfaction. For pastoralists, social adaptation is a central expression of life satisfaction. Dai et al. (2020) concluded that the level of social adaptation is significantly and positively correlated with life satisfaction, and each unit increase in social adaptation will increase life satisfaction by 0.13. Li et al. (2014) noted that urban migrant workers use the social support they receive to better adapt to society, thus increasing their life satisfaction. It is clear that there is a strong link between social adaptation and life satisfaction.

In summary, social adaptation generally reflects the extent to which pastoralists have adapted to the new production, lifestyle, cultural, psychological, and interpersonal aspects of the post-migration period. The level of social adaptation affects the life satisfaction ratings of pastoralists. The higher the level of social adaptation of migrants, the more satisfied they are with their lives. Accordingly, we propose hypothesis H2.

H2: The higher the level of social adaptability, the higher the life satisfaction of ecological migrants.

2.3 Impact of livelihood capital and social adaptation on life satisfaction

The level of livelihood capital of pastoralist households directly affects not only the quality of life of pastoralists but also their social adaptation (Tai et al., 2019). Based on the previous section, it is clear that social adaptation has a positive effect on pastoralists' life satisfaction. Livelihood capital indirectly affects pastoralists' life satisfaction through social adaptation. This indirect effect may have a diminishing impact owing to social adaptation problems, and thus is smaller than the direct effect of household livelihood capital on satisfaction. Accordingly, we propose hypothesis H3.

H3: Livelihood capital can indirectly influence life satisfaction through social adaptation, but to a lesser extent than the direct influence of livelihood capital.

The theories of sustainable livelihoods and social adaptation form the basis of the proposed theoretical and analytical framework. This study applies two theories to determine the relationships between livelihood capital, social adaptation, and life satisfaction of ecological migrants. The theoretical framework of this analysis is shown in Figure 1.

3 Data sources and research methods

3.1 Study area overview and study population

Located in the Ili Kazakh Autonomous Prefecture, Kalajun is situated in the northern foothills of the Bi'ik Mountains in Central Tianshan. It consists of mountains stretching for nearly 100 km, making it the most typical area for the distribution of the second- and third-level razor planes of the TianShan mountain system. The central point of its geographical position is 82°01′22′E, 43°03′21″N, with an altitude of 2000–3,957 m and a total area of 2,848 km^2. Kalajun is a typical mountain meadow-type grassland. In November 2016, Kalajun was successfully designated as a national 5A-level tourist attraction, ranking 10th in Xinjiang and second in Ili Prefecture. With its stunning natural scenery and unique Kazakh nomadic grassland style, the Kalajun Scenic Area is a tourist

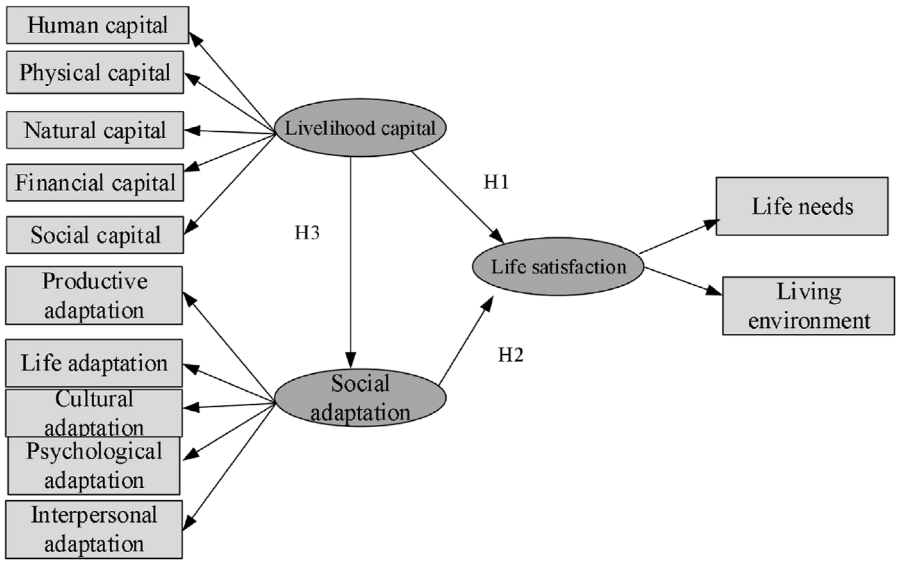

FIGURE 1
Theoretical analysis framework.

destination that combines sightseeing, outdoor adventure, and scientific research.

Since 2013, the Kalajun World Natural Heritage Site has implemented a top-down ecological migration policy. Ecological migration in Kalajun is a process whereby the government moves people with limited livelihoods out of their original homes to protect the ecological environment of the World Natural Heritage Site. There are two layers to this. First, the herders' place of residence is changed. The government provides them with resettlement housing, and the herders have permanent homes in the settlement with easy access to electricity and water. Second, there is a change in the livelihoods of migrants. Pastoralists transition from a single livelihood of herding to a diversified livelihood of herding, tourism, and animal husbandry.

The implementation of no-grazing and grazing restriction policies has reduced the number of sheep kept by herders. However, cattle and horses are not used as the main means of livelihood and transport for families, and herders still mostly live in nomadic herding communities in the mountains in summer and winter in winter dens or settlements. In terms of tourism employment placement, some herdsmen in Kabusalang village have been placed in the East Kalajun scenic area at the Flower Terrace, Falcon Terrace, and other inter-district bus stops selling cold food stalls for groceries. The number and capacity of herders in the village of Kalajun that can run herding operations near Wusunxiadu and Kuokesu are very limited. Two teams of horses from the Manati Tourist Farmers' Cooperative and the Qiongkushitai White Horse Cooperative in the Kerala Scenic Area offer horse hires to tourists in the villages of Falcon Terrace and Qiongkushitai, respectively. The cooperative has approximately 200 horses, and it is run and managed as a professional cooperative of herders. Herdsmen are given shares in their own horses and receive a share of the proceeds of their operations. Herdsmen also earn wages for their services in leading horses for tourists at the Horse Guards.

3.2 Data sources

Data were obtained from a field survey of ecological migrant herding households in the Tianshan World Natural Heritage Site, Xinjiang, conducted by the research team in June 2019 using stratified clustering and random sampling methods. The survey covered the basic situation of pastoralist households, stock of livelihood capital, adaptation to various aspects of migration, and evaluation of life satisfaction.

Considering the ecological protection policy and the progress of ecological migration work, the Kalajun World Natural Heritage Site was selected as the research site. The area covers four townships in Turks County: Kalajun Township, Teks Horse Farm, Qorak Tiezhek Township, and Cok Tiezhek Township. Considering the differences in population size and livelihood patterns in each township, one or two villages were selected in each township, and the research covered eight villages (teams) across four townships. In each village, 30–40 herding households were randomly selected as the research sample. As most of the survey respondents were Kazakh herders, the research team hired two Kazakh university students as interpreters to reduce communication difficulties and improve the efficiency and accuracy of the questionnaire distribution. A surveyor and interpreter questioned the herding households two–to-one and filled in the questionnaire. A total of 200 questionnaires were obtained from herding households; 20 invalid and seriously missing questionnaires were deleted and 180 valid questionnaires were obtained, for a validity rate of 90.0%.

The basic characteristics of the herding households in the sample are summarised in Table 1. The respondents were predominantly male pastoralists aged 36 years and older, with 6.67% aged 65 years and older. The average number of years of education among the herding households interviewed was 6.28 years, and only 6% of the herding households had received high school education or above. The percentage of households with village representatives among the

TABLE 1 Characteristics of sample herdsmen.

Variables		Sample size/household	Proportion (%)
Gender	Male	117	65
	Female	63	35
Age	<35 years old	72	40
	36–45 years old	49	27.22
	46–65 years old	47	26.11
	>65 years old	12	6.67
Education level	Not educated	24	13
	Primary Schools	102	57
	Lower Secondary	43	24
	Senior Secondary and above	11	6
Is there a village representative in the home	Yes	46	26
	No	134	74

interviewed herding households was 26%. Overall, the characteristics of the sample herding households appeared to be consistent with the fact that herders in the main grassland pasture areas of the Tianshan Mountains in Xinjiang have low levels of education.

3.3 Measurement of variables

Based on a previous theoretical analysis, livelihood capital, social adaptation, and life satisfaction were selected as the key variables. The specific measures are listed in Table 2.

Livelihood capital comprises five categories. Human capital is measured as the number of pastoralist household labourers. Physical capital is measured as the number of livestock owned by a herder's household. Natural capital is measured as the area of pasture owned by the herder households. Financial capital is measured as the annual income of the herder household.

Social capital is measured as the total number of friends, followed by household members, in social software.

Social adaptation includes five types of adaptation. Social adaptation was measured using a five-point Likert scale (very reluctant = 1; reluctant = 2; average = 3; willing = 4; very willing = 5 and always = 1; often = 2; occasionally = 3; less often = 4; never = 5). Productive adaptation is measured by "the extent to which herders are satisfied with non-pastoralist production methods". Adaptation to life is measured by "the extent to which herders experience and feel the settled way of life". Cultural adaptation is measured by "the extent to which pastoralists feel the folklore and customs of the settlement". Psychological adaptation is measured by "the frequency with which pastoralists tend to become agitated and depressed when they encounter difficulties". Interpersonal adaptation is measured by the "willingness of herders to participate in neighbourhood meetings".

Life satisfaction was measured using a five-point scale (very dissatisfied = 1; dissatisfied = 2; fair = 3; satisfied = 4; very satisfied = 5). Satisfaction with livelihood needs is measured by the "satisfaction level of pastoralists with their present needs in terms of livelihood". Satisfaction with the living environment is measured by "the extent to which pastoralists are satisfied with the living environment of the settlement".

In terms of livelihood capital, the majority of households have a labour force of two to three persons, as young people tend to go out to work or move to the county. The implementation of the grazing ban led to a reduction in the pasture area for herding families, with pasture areas mostly distributed between 6.67 and 20 hm^2. The number of herders raising livestock has decreased accordingly, with livestock numbers generally ranging from 51 to 150. Most herder households have an annual income of RMB 50,000 to 90,000, which is in the upper middle range. The total number of friends and family members is between 101 and 200.

In terms of social adaptation, herders' satisfaction with the adaptation of folk customs and practices is high, with the highest mean value of 3.84. This reflects the fact that the "new folk customs" in the settlement have been passed on from the pre-settlement folk customs, and herders are thus more likely to adapt to these customs. The mean value of herders' adaptation to new production methods and getting along with their neighbours is 3.67, which indicates that most herders are adapting well to production methods and neighbourhood relations.

In terms of life satisfaction, the average value of herders' life needs is 3.86, which indicates that herders' satisfaction with life needs is at the middle to upper level, but there is still room for improvement. The average value of the herders' satisfaction with their living environment in the settlements is 3.33. As the infrastructure of the settlements has not yet been improved, further improvements in the human living environment need to be made.

4 Results and analysis

4.1 Confidence analysis and validation factor analysis

As summarised in Table 3, the Cronbach's alpha coefficients for the three latent variables of capital endowment, social adaptation,

TABLE 2 Variable meanings and descriptive statistical analysis.

Potential variables	Observed variables	Variable assignment	Mean	Standard deviation
Livelihood capital	Human capital	Number of family workers: 1 person = 1; 2 persons = 2; 3 persons = 3; 4 persons = 4; 5 and more = 5	2.53	1.266
	Physical capital	Number of livestock owned by the household: 0–50 = 1; 51–100 = 2; 101–150 = 3; 151–200 = 4; 201 and above = 5	2.72	1.191
	Natural capital	Area of pasture owned by families: 0–6.67 hm^2 = 1; 6.67–13.33 hm^2 = 2; 13.33–20 hm^2 = 3; 20–26.67 hm^2 = 4; 26.67 hm^2 and above = 5	2.58	1.294
	Financial capital	Annual household income: RMB 30,000 and above = 1; RMB 30,000–50,000 = 2; RMB 50,000–70,000 = 3; RMB 70,000–90,000 = 4; RMB 90,000 and above = 5	3.08	1.091
	Social capital	Total number of good friends: 0–50 persons = 1; 51–100 persons = 2; 101–150 persons = 3; 151–200 persons = 4; 201 and above = 5	3.13	0.965
Social Adaptation	Productive adaptation	Are you satisfied with the "non-pastoralist" approach to production? Very dissatisfied = 1; dissatisfied = 2; fair = 3; satisfied = 4; very satisfied = 5	3.67	0.784
	Life adaptation	How do you feel about the settled lifestyle? Very dissatisfied = 1; dissatisfied = 2; fair = 3; satisfied = 4; very satisfied = 5	3.26	0.887
	Cultural adaptation	How do you feel about the folklore of the settlements? Very dissatisfied = 1; dissatisfied = 2; fair = 3; satisfied = 4; very satisfied = 5	3.84	1.079
	Psychological adaptation	Do you tend to get anxious and depressed when you encounter difficulties? Always = 1; Often = 2; Occasionally = 3; Rarely = 4; Never = 5	3.41	0.907
	Interpersonal adaptation	Would you like to attend a neighbourhood meeting? Very reluctant = 1; Reluctant = 2; Fair = 3; Willing = 4; Very willing = 5	3.67	0.909
Life satisfaction	Life Needs	How satisfied are you with your current needs in life? Very dissatisfied = 1; dissatisfied = 2; fair = 3; satisfied = 4; very satisfied = 5	3.86	1.199
	Living Environment	How satisfied are you with the living environment of the settlement? Very dissatisfied = 1; dissatisfied = 2; fair = 3; satisfied = 4; very satisfied = 5	3.33	0.859

and life satisfaction are 0.873, 0.677, and 0.768, respectively. The Cronbach's alpha reliability coefficient for the questionnaire as a whole is 0.800, all of which are greater than 0.6, indicating that the reliability of this study is credible (Wu, 2009).

To examine whether the questionnaire data meet the requirements for factor analysis, KMO and Bartlett's sphere test values were used for evaluation. The KMO statistic for the scale is 0.816, which is much greater than the minimum standard of 0.6. The Bartlett's sphere test chi-square value is 871.057 ($p < 0.001$), and the post-rotation factor loadings for all variables are greater than the standard of 0.5.

4.2 Overall model fitness test

The hypothetical model for this study was developed using Amos software (version 26.0), and the overall goodness of fit was obtained through data analysis. The chi-squared degrees of freedom ($\chi 2/df$) ratio is 1.390, which is less than 3; the RMSEA value is 0.047, which is less than 0.08; and the GFI, NFI, IFI, TLI, and CFI indicators are all greater than 0.9, and thus all of these indicators meet the requirements. These results are summarised in Table 4.

4.3 Model estimation results and analysis

The various relationships reflected in the model in the text are summarised in Table 5.

(1) The magnitudes of the contributions of the five observable indicators reflecting livelihood capital are: financial capital (0.811), natural capital (0.806), physical capital (0.761), human capital (0.747), and social capital (0.699).
(2) The contributions of the five observable indicators reflecting social adaptation are: cultural adaptation (0.813), adaptation to life (0.669), psychological adaptation (0.662), productive adaptation (0.098), and communicative adaptation (0.066).

TABLE 3 Variable reliability analysis and exploratory factor analysis.

	Name of variable	Rotation factor loadings	Cronbach's α
Livelihood capital	Human capital	0.791	0.873
	Physical capital	0.822	
	Natural capital	0.850	
	Financial capital	0.827	
	Social capital	0.759	
Social adaptation	Productive adaptation	0.678	0.677
	Life adaptation	0.747	
	Cultural adaptation	0.810	
	Psychological adaptation	0.716	
	Interpersonal adaptation	0.597	
Life satisfaction	Life needs	0.631	0.768
	Living environment	0.597	

TABLE 4 SEM overall fitness test results.

Evaluation indicators	χ2/df	RMSEA	GFI	NFI	IFI	TLI	CFI
Models	1.390	0.047	0.931	0.904	0.971	0.963	0.970
Recommended value	≤3	≤0.08	≥0.9	≥0.9	≥0.9	≥0.9	≥0.9
Results	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent

TABLE 5 Test of significance of path coefficients.

Paths			Standardised path	S.E.	C.R.
			Path factor		
Social adaptation	←	Livelihood capital	0.244**	0.092	2.735
Life satisfaction	←	Social adaptation	0.530***	0.158	4.46
Life satisfaction	←	Livelihood capital	0.173**	0.118	2.008
Social capital	←	Livelihood capital	0.699		
Financial capital	←	Livelihood capital	0.811***	0.135	9.672
Natural capital	←	Livelihood capital	0.806***	0.158	9.792
Physical capital	←	Livelihood capital	0.761***	0.148	9.098
Human capital	←	Livelihood capital	0.747***	0.157	8.943
Interpersonal adaptation	←	Social adaptation	0.066		
Psychological adaptation	←	Social adaptation	0.662***	0.112	7.734
Cultural adaptation	←	Social adaptation	0.813***	0.131	9.634
Life adaptation	←	Social adaptation	0.669***	0.108	7.884
Productive adaptation	←	Social adaptation	0.098	0.092	1.198
Life needs	←	Life satisfaction	0.770		
Living environment	←	Life satisfaction	0.855***	0.122	6.502

*, **, and *** indicate significant at the 10%, 5%, and 1% statistical levels, respectively.

(3) The magnitudes of the contributions of the two observable indicators reflecting life satisfaction are: living environment (0.855) and life needs (0.770). This shows that financial and natural capital contribute more to livelihood capital, while cultural, life, and psychological adaptation contribute more to social adaptation.

Based on the results of the path analysis, the hypotheses of this study were tested. The results show that livelihood capital significantly and positively influences social adaptation at the 5% level ($\beta = 0.244$, $p < 0.05$). Social adaptation significantly and positively affects life satisfaction at the 1% level ($\beta = 0.530$, $p < 0.001$). Livelihood capital significantly and positively influences life satisfaction at the 5% level ($\beta = 0.173$, $p < 0.05$). The results verify H1 and H2, i.e., both social adaptation and livelihood capital positively affect life satisfaction, and the degree of influence of social adaptation is significantly greater than that of livelihood capital. The key to improving migrants' life satisfaction thus lies in enhancing their social adaptation ability.

The estimated results from the standardised pathways show that the path coefficient for the effect of livelihood capital on social adaptation is 0.244. The path coefficient for the effect of social adaptation on life satisfaction is 0.530. The effect of livelihood capital on life satisfaction can be divided into two paths: direct and indirect. The direct effect (livelihood capital → life satisfaction) is 0.173.

The indirect effect (livelihood capital → social adaptation → life satisfaction) is $0.244 \times 0.530 = 0.129$, and the total effect is 0.302. Thus, H3 is verified, i.e., the indirect effect of livelihood capital on life satisfaction through social adaptation (0.129) is smaller than the direct effect (0.173).

The total effect of livelihood capital on life satisfaction (0.302) is also smaller than that of social adaptation on life satisfaction (0.530). Again, this confirms that enhancing the social adaptation of migrants is key to enhancing their life satisfaction.

5 Conclusions and discussion

5.1 Conclusions

This study empirically analyses the influence of livelihood capital and social adaptation on life satisfaction based on a theoretical model of the relationship between them. It further compares and analyses the differences in the influence of livelihood capital on two direct and indirect paths of life satisfaction to identify the key factors affecting pastoralists' life satisfaction. The conclusions are as follows.

(1) Most of the sample herding households' livelihood capital in terms of household labour force, pasture area, number of livestock, annual household income, and total number of close friends of household members are at a medium level, and the livelihood conditions of herding households are average. In the social adaptation dimension, the herders are more satisfied with the cultural adaptation. The "new folklore and customs" in the settlements are inherited from the pre-settlement folklore and customs, and thus it is easier for migrants to adapt. The mean value of 3.67 for pastoralist adaptation to production and interpersonal adaptation indicates that the majority of pastoralists are well adapted to production methods and neighbourhood relations. Herders' satisfaction with their living needs is medium to high, but there is still room for improvement. The infrastructure of the settlement has not yet been improved, and the living environments of the herders need to be further improved.
(2) Financial and natural capital have the greatest contributions to livelihood capital. Cultural, life, and psychological adaptation contribute more to social adaptation.
(3) Both livelihood capital and social adaptation have a significant positive effect on life satisfaction, i.e., pastoralists with higher levels of social adaptation are more likely to have stable social relationships and higher life satisfaction. The higher the level of livelihood capital, the greater the pastoralists' ability to obtain livelihood security, and the higher the level of life satisfaction will be.
(4) The direct effect of social adaptation on life satisfaction is significantly greater than the direct effect of livelihood capital, indicating that life satisfaction is influenced more by social adaptation. Although some herding households have a high level of livelihood capital, their life satisfaction remains low because of their lack of social adaptation.
(5) The direct pathway impact of livelihood capital on life satisfaction is greater than its indirect pathway impact. Improving the life satisfaction of ecological migrants thus begins with the direct impact of pastoralist households' livelihood capital.

5.2 Discussion

In the context of the new era of grassland ecological civilisation, the relationship between ecological protection and human wellbeing is becoming increasingly close. Since the implementation of the ecological migration policy, the production and way of life of traditional Kazakh herding families has changed dramatically. These changes have included transitions from nomadic herding to settlement and herding cattle and sheep to travelling and doing business. Under the guidance of the ecological migration policy, herders have gradually participated in the tourism business, completing an identity change from herders to businesspeople. However, any change comes with 'pain', and the implementation of policies such as ecological migration, resettlement, and community participation in tourism operations is not an overnight process, but rather a gradual one, in which the new generation of herders show a strong desire for a new life and a more modern lifestyle than the nomadic life of their fathers. In addition, the ecological migration policy has changed the traditional production and lifestyle of pastoralists in ethnic areas while reshaping their perceptions of a better life, which in turn affects their expectations and perceptions of wellbeing. Both livelihood capital and social adaptation have a significant impact on life satisfaction; however, social adaptation has a significantly greater impact on life satisfaction than livelihood capital.

Therefore, the level of livelihood capital is no longer the main factor in measuring happiness, which confirms the paradox between economic growth and happiness, where the happiness of the

population does not increase consistently with economic growth. When physiological and security needs are met, the pursuit of higher-level needs, such as socialisation, respect, and self-actualisation, will enhance happiness. This means that along with increasing the level of livelihood capital of pastoralists, an increase in the level of cultural adaptation, interpersonal adaptation, and psychological adaptation will contribute more to the life satisfaction of pastoralist Kazakh ecological migrants.

This requires governments to implement ecological migration policies that focus on the social adaptation of migrant groups, while introducing employment and subsidy policies. The government should conduct seminars and surveys to determine how migrant groups have adapted to existing production methods, lifestyles, and interpersonal relationships. Based on the current situation, migrant support policies can be actively adjusted to effectively address the difficulties faced by migrant groups. Thus, the "ecological migration" can become not just a simple "physical" migration, but also encompass "spiritual" protection of the migrant group. Measuring the effectiveness of implementing migration policies in terms of the satisfaction of ecological migrants is more conducive to reflecting the shortcomings of ecological migration work and identifying directions for policy improvement.

Given that the case sites selected for this study were specific study areas dominated by Kazakh herders, there may be limitations to the replication of these findings among other ecological migrant groups; this study will continue to be further developed in the future to enhance its replication value.

In consideration of this, the following countermeasures are proposed:

(1) A comfortable living environment should be created by "combining movement and tranquillity", and the social adaptation level of herders should be enhanced. Public infrastructure such as roads, street lights, fitness equipment, and squares in resettlement sites should be improved to enhance the quality of public services in the community, and the living environment should be improved to create a beautiful and liveable village. At the same time, regular community group activities should be organised to create opportunities for friendly neighbourhood interactions. By organising grassland cultural exhibitions and selecting outstanding cultural works, herders can enhance their sense of pride and identity in grassland culture. By organising sports and entertainment activities, they can create spaces for neighbourly exchanges and widen their friendship circles. Finally, we should pay attention to the psychological health of herders, set up rural spiritual exchange stations, conduct psychological exchange seminars, provide psychological counselling services, and teach psychological stress reduction methods to increase herders' psychological resilience.

(2) "Internal and external training" should be conducted to build strong employment skills and improve herders' level of capital endowment. This can provide practical opportunities to the leading and exemplary roles of large-scale breeders and capable grassland tourists and improve the comprehensive quality of herders and enhance their livelihood capabilities. A platform for skills training and exchange should be built, and new media platforms such as WeChat, Jitterbug, and Express can be used to push out relevant support policies and skills training courses to reduce the difficulty of accessing information for herders. Rural livestock breeding and tourism business skills training and exchange stations have been established, and government policies such as preferential subsidies have been used to fully mobilise the initiative of large-scale breeders and grassland tourism operators, thus encouraging them to provide technical guidance to herders at the skills training and exchange stations on a regular basis. This fully utilizes the government's role of guaranteeing the bottom line and formulating policies on preferential subsidies to encourage herders to start their own businesses *in situ*. To promote the development of grassland ecotourism and industrial integration, herders are encouraged to develop diversified livelihood models in which tourism operations, large-scale farming, and animal husbandry coexist. This can be achieved by actively widening financing channels, opening additional "green channels" in bank branches and credit unions, increasing the amount of micro-credit, and enhancing policy subsidies.

(3) Capital endowments for social adaptation should be used to indirectly enhance herders' satisfaction with their livelihoods. This can make full use of the advantages of capital endowments to compensate for the shortcomings of social adaptation. First, this can make use of the initiative of herders and social capital of herder families, allowing them to find common friends in the neighbourhood through communication with friends and relatives and reconstruct social networks to enhance migrants' interpersonal adaptation. Second, it makes use of the advantages of the family's human and financial capital to develop the employment skills of herder families' labour force, invests capital in production and business, and carries out diversified livelihood activities to enhance migrants' productive adaptation. Moreover, the family's human and financial capital can be used to develop the labour skills of pastoralist families, invest their capital in productive businesses, and diversify their livelihood activities to enhance the productive adaptation of migrants.

Data availability statement

The raw data supporting the conclusion of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

JH: Conceptualization, methodology, formal analysis, investigation, validation, writing-original draft, writing review and editing. JY: Conceptualization, super-vision, writing-original draft, writing-review and editing. CX: Resources, data curation, software, visualization. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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