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The Impact of Individual Capabilities on Ecosystem Services and Farmers' Well-Being: A Case Study of the Loess Plateau, China

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Abstract: Exploring the impact of individual capabilities on ecosystem services and farmers' well-being is conducive to discovering the complex relationship between ESs and human well-being, and has clear practical value for the sustainable management and improvement of farmers' well-being in ecologically fragile areas in China. An importance–accessibility index of ESs was constructed and the objective well-being and subjective well-being of farmers were assessed. Subsequently, the relationship among capabilities, ESs, and well-being was elucidated based on a structural equation model. The results showed that fruits, pest control, fuelwood, water conservation, and wild food were the ES types that contributed most to farmers' well-being. There were some similarities and differences between the dimensions of objective and subjective well-being. For example, farmers with adequate leisure time reported higher leisure satisfaction and farmers with relatively adequate income levels reported the lowest income satisfaction. The direct effect of capabilities on ESs and objective well-being was significant, and the direct effect of capabilities on their subjective well-being was not significant. Their capabilities had a significant indirect impact on their objective well-being by influencing ESs and did not have a significant indirect impact on their subjective well-being by influencing ESs; their capabilities had a significant indirect impact on their subjective well-being by influencing the ESs and objective well-being. Physical health, mental health, and agricultural skills were the key types of capabilities that influenced the farmers' access to ESs and well-being. Improving these capabilities can enable local farmers to more fully access ESs and improve their well-being.

Keywords: ecosystem services; social perception; objective well-being; subjective well-being; farmers' capabilities; structural equation model

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1. Introduction

Ecosystem services (ESs) are the various types of material and immaterial benefits that people derive from ecosystems [1]. Human well-being represents the objective and subjective feelings about an individual's life [2]. Maintaining a positive relationship between ESs and human well-being is an important goal for regional sustainable management [3–5]. After the introduction of the Millennium Ecosystem Assessment (MA), several researchers revealed the significant impact of ESs on human well-being through empirical studies. For example, regression analyses and spatial coupling have been widely used to reveal the impact of ESs on human well-being [6–8]. These methods have yielded influential results, but there has been a lack of research on the processes by which ESs affect human well-being. Social preference and the perceived assessment of ESs and human well-being are popular research topics [9,10]. Although such studies explain the different effects of ESs on well-being, the reasons for the these differences have not yet been effectively analyzed [11].

Therefore, further studies are needed to better understand the factors influencing ESs and human well-being.

Ecosystem services are often measured in terms of their values, which include monetary value, sociocultural value, and ecological value [11]. Research on the monetization of ES values is a popular topic [12,13]. However, many ESs are non-monetized. For example, leisure as a cultural value is intangible, yet it is still important to human well-being [14,15]. The non-monetary value of ESs is often explained through the method of social preferences [16,17]; this method is considered to be an emerging tool for solving ecological problems and understanding individual needs for ESs [18,19]. For example, in some areas with high resource dependence, a farmer's social preference for the importance of ESs represents their expectation and need for these ESs, which is effective in promoting local poverty alleviation and development [20]. However, just because a particular ES is demanded by a certain type of group does not mean that this ES contributes to the well-being of that group [21,22]. For example, women who collect shells on the coast agree that mangroves are important shade shelters, and these shelters improve their social relationships and well-being, but not all scavenging women have access to mangroves, which leads to differences in their well-being [20]. Therefore, considering the importance and accessibility of ESs is necessary to reveal their true impact on individual human well-being, the understanding of which is still lacking in this area of research.

The Millennium Ecosystem Assessment divides human well-being into five dimensions: basic materials; safety; health; good social relationships; and freedom and choice [23]. These dimensions are interrelated and impact each other, and changes in one dimension will have a positive or negative impact on the other dimensions [24]. In addition, human well-being has hierarchical connotations in that people only meet their basic needs (i.e., objective well-being, such as diet and health) before they meet their higher needs (i.e., subjective well-being, such as satisfaction and freedom) [25]. Therefore, Costanza et al. and Leviston et al. have divided human well-being into objective well-being and subjective well-being [1,26], aiming to explain more clearly the complex relationships within human well-being, which is essential for a deeper understanding of people's livelihoods. Farmers living in ecologically fragile areas face high livelihood risks due to their excessive dependence on local ecosystems, which results in lower quality of life and well-being [27]. By giving attention to the importance and accessibility of different ESs to farmers, the government can determine the special needs of farmers for ESs and the difficulty of obtaining specific ES types and promote the formulation of ecological policies by the government to be more targeted and effective [17,28]. The satisfaction of needs and adequate access to ESs can not only improve people's income and other aspects of their objective well-being [29–31] but also increase their subjective well-being, such as life satisfaction and happiness [4,32,33]; thus, ESs can help them enhance their multidimensional well-being. However, in academic studies [12,19], the impact of ESs on human well-being has mostly been limited to the impact of a single dimension of objective well-being or subjective well-being. There are few studies that have integrated objective and subjective well-being.

Exploring the factors affecting ESs and human well-being is the focus of related research in this field. Differences in the extent to which individuals receive ESs represent, to some extent, the differences in the benefits that individuals derive from ESs [21], and the reasons for such differences can be attributed to capabilities, i.e., the conditions that enable individuals to produce or access ESs and benefit from them in some way [34]. Numerous studies have identified capabilities as an important factor in improving well-being [35,36]. For example, the accessibility of fuelwood is greater for physically healthy farmers, which improves their human well-being [37]; Sangha et al. argued that well-being improves if well-being policies focus on empowering indigenous people and enabling them to lead healthy lives [38]. To date, several studies have identified key individual competencies such as physical health, ecological knowledge, and livelihood capital [34,38,39]. These competencies can have varying degrees of impact on the well-being of individuals, but most of these studies are qualitative in nature. There has been some progress in the research

on capabilities, ESs, and human well-being [21,22], but we lack experimental evidence on which individual competencies affect which dimensions of ESs and human well-being.

From the existing research findings [19,22,25,38], on the one hand, there is a lack of integrated studies on the importance and accessibility of ESs and the integrated assessment of objective well-being and subjective well-being. On the other hand, it is necessary to further explore the impact of individual capabilities on ESs and human well-being. The Loess Plateau in China was chosen as the study region in this paper because this region is one of the most ecologically fragile areas and a key area for poverty alleviation and rural revitalization in China. Local farmers rely heavily on the diverse ESs provided by the natural environment, which leads to a contradiction between the economy and ecology and poses a challenge to the sustainable development of regional ecosystems. Through long-term agricultural production and experience, farmers have developed many capabilities that are useful for accessing ESs [22]. The improvement of farmers' capabilities is important for improving the accessibility of ESs as well as the well-being of farmers in this region. In this paper, we analyzed the impact of farmers' capabilities on ESs and human well-being. First, the farmers' capabilities, perceptions of ESs' importance and accessibility, and objective and subjective well-being were recorded through a questionnaire survey. Second, the farmers' capabilities, perceptions of ESs, and levels of human well-being were analyzed. Finally, the impacts of farmers' capabilities on ESs and human well-being were explored based on a structural equation model [5]. The results of this study can advance the sustainable development of regional ecosystems and farmer well-being by identifying key competencies that enable better access to ESs.

2. Materials and Methods

2.1. Study Area

The Loess Plateau is one of the most severely eroded soil areas in the world and one of the most economically deprived regions in China. Mizhi County is located in the middle of the Loess Plateau and is a typical loess area with hills and gullies (Figure 1). The region has a mid-temperate semi-arid climate. The climate is characterized by four distinct seasons and equivalent periods of rain and heat. The annual amount of precipitation is generally low, and the precipitation is concentrated in summer. Nine droughts over ten years have been the main feature of the agricultural system in this region, as the lack of precipitation has seriously affected local crop cultivation and has led to the instability of local farmers' livelihoods. Landslides and flash floods can occur in summer at random, threatening the personal safety of farmers; these disasters also lead to severe nutrient loss from loess soils. In 1999, the Chinese government implemented a policy of returning farmland to forests on the Loess Plateau. Over the past two decades, the area of forest and grassland in Mizhi County has increased. Farmers began to obtain fuelwood from the forest for cooking and heating. In addition, most of the forests that resulted from the farmland retreat are economic forests (date palm trees, apricot trees, etc.) and thus provide income. Farmers pick wild dates and almonds for sale and self-consumption during their leisure time in the summer and autumn of each year. Since the Chinese government implemented a policy of precise poverty alleviation in 2015, the agricultural production structure of these farmers has changed. The combination of crop cultivation and animal husbandry has become a new trend. The government's promotion of apples has also provided new pathways for farmers to improve their living standards. In Mizhi County, local farmers rely heavily on the diverse ESs provided by the natural environment, and they have developed many capabilities that are beneficial for obtaining ESs [22]. Thus, this area is suitable for studying the impact of farmers' capabilities on the benefits they receive from ESs and their well-being.

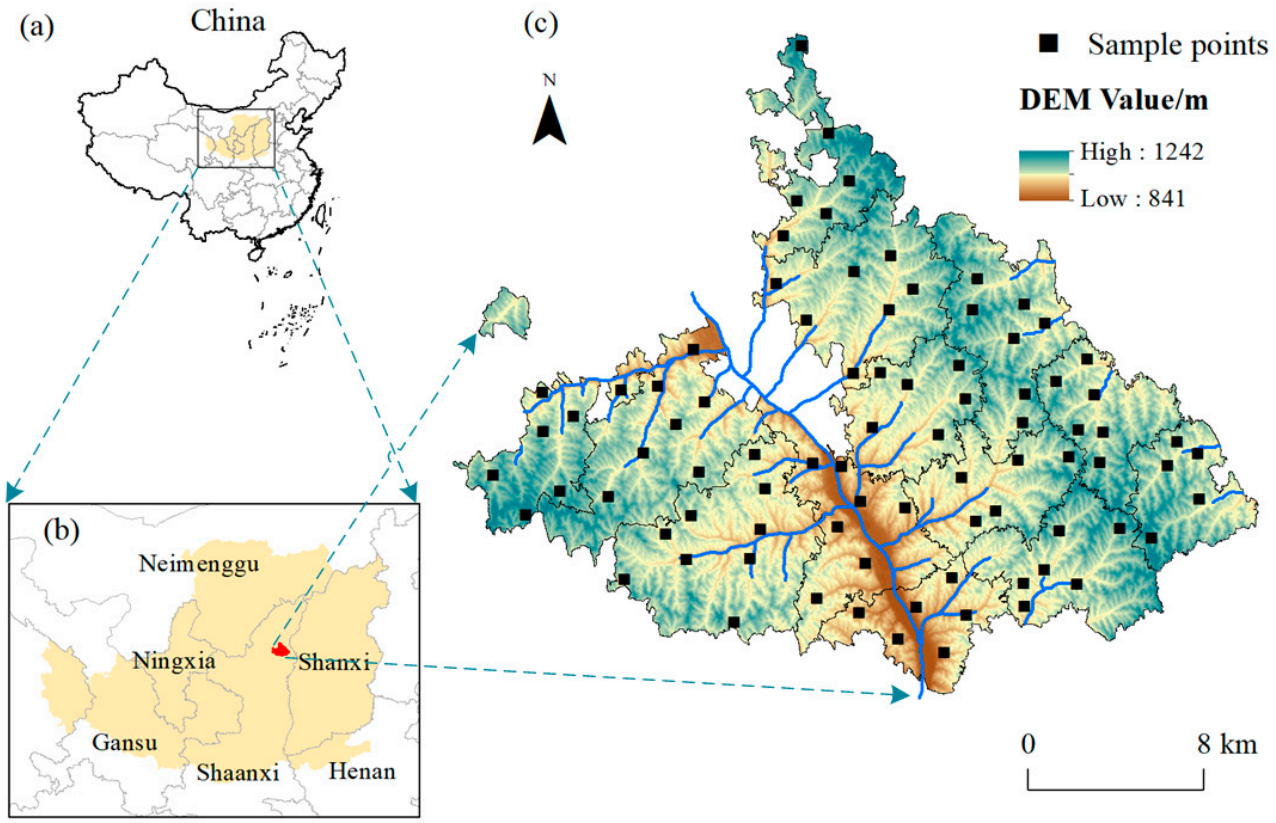

Figure 1. Overview of the study area and selection of sample villages. (Note: (**a**) the location of the Loess Plateau; (**b**) the location of Mizhi County on the Loess Plateau; (**c**) the spatial distribution of the sample points).

2.2. Analytical Framework and Research Hypotheses

Individual capabilities provide a way to understand the complex relationship between ESs and human well-being. The literature has explored how individual capabilities explain how ESs improve human well-being [35,38,40]. For example, Sangha et al. noted that the connection between people and nature is not limited to the services provided by ecosystems, but also includes people's abilities to access those benefits [38]. Farmers' capabilities are the key factor that dominates farmers' livelihood strategies [20,41]. For example, good mobility is essential for obtaining food through agricultural practices [12] and positive communication skills help farmers obtain more organic fertilizer or feed from their friends and communities [22]. Similarly, the impact of individual capabilities on human well-being is clear. Studies have shown that capabilities related to different economic activities have a significant impact on female income [42] and that forest- or ocean-related capabilities have a significant impact on inhabitants' subjective well-being [43,44].

We analyzed the impact of ESs on human well-being, and the relationships within human well-being that are necessary to understand the paths by which capabilities impact ESs and well-being. The MA clearly revealed the outstanding contribution of ESs to human well-being, which is even more evident in resource-dependent regions [17,28,45,46]. For example, provisioning services such as food production have a significant impact on rural household income [12], while regulating services such as water conservation have a significant impact on the subjective well-being of elderly people [4]. Due to the differentiated impact of ESs on farmers' well-being, the importance and accessibility of ESs to farmers is actually a true expression of farmers' differentiated needs for and access to ecosystem benefits [21,22]. Human well-being includes objective well-being and subjective well-being [26]. Objective well-being is a dimension of human well-being related to material conditions, health, safety, and other objective elements [47]. Subjective well-being relates to

individuals' perceptions and feelings, including satisfaction and emotion [48]. Individuals tend to report their life satisfaction according to their living standards [27,49,50]. Many studies have reported the positive effects of objective factors such as income, health, and social relationships on individuals' subjective well-being [51–53].

Based on the above analysis, six research hypotheses related to the impact of ESs on human well-being were proposed for this paper (Figure 2).

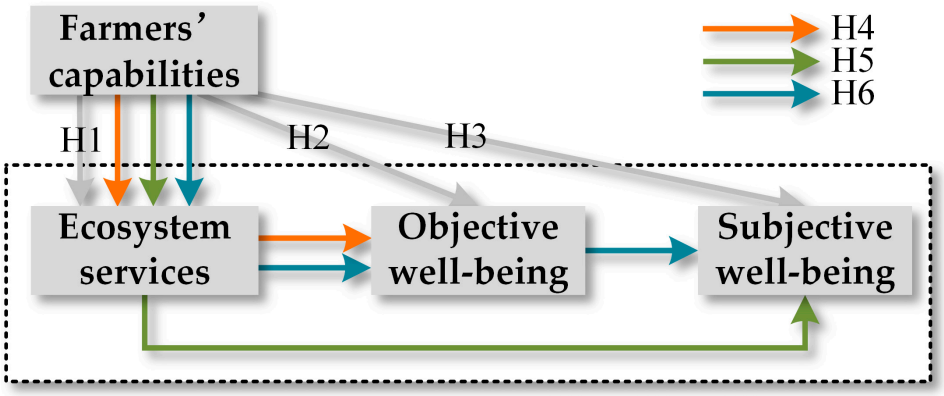

Figure 2. Analysis framework.

The hypotheses are as follows:

H1: *Farmers' capabilities have a direct positive impact on their ESs;*

H2: *Farmers' capabilities have a direct positive impact on their objective well-being;*

H3: *Farmers' capabilities have a direct positive impact on their subjective well-being;*

H4: *Farmers' capabilities have an indirect positive impact on their objective well-being through ESs;*

H5: *Farmers' capabilities have an indirect positive impact on their subjective well-being through ESs;*

H6: *Farmers' capabilities have an indirect positive impact on their subjective well-being through ESs and objective well-being.*

2.3. Data Collection and Analysis

The questionnaire survey data were integrated from the field survey conducted by the research team in October 2020 and July 2021. Based on the stratified sampling method, 84 villages were selected for the field research considering the differences in geography and socioeconomic conditions in the study region (Figure 1). Stratification was based on the 4 types of villages in Mizhi County: The first type is agricultural villages (187, accounting for 47.22%), which mainly focus on traditional agricultural cultivation (such as potatoes and millet). The second type is economic villages (64, accounting for 16.16%), which mainly focus on economic agriculture (such as red onions and apples). The third type is ecological villages (61, accounting for 15.40%), which mainly focus on returning farmland to forests and ecological restoration. The fourth type is urban villages (84, accounting for 21.21%), which are mainly residential living areas, where farmers mainly plant crops in small areas. We selected 40, 13, 13, and 18 villages of these 4 village types, respectively, which is basically consistent with the proportions of the 4 village types in relation to the overall villages, and meets the requirements of the stratified sampling method. Therefore, these samples well represent the general situation of Mizhi County.

The study area is located in the Loess Plateau. Affected by the topography of the region, the housing of farmers in the study area mostly has a banded distribution. Therefore, a sample belt walking method was adopted in this paper to obtain the sample farmers [30]. The research team took the village committee as the center, and a driver or accountant who was familiar with the terrain was employed as the guide and carried out the sample

walking. The sample farmers were randomly selected from the sample belt, and the selected farmers were basically representative. The research team conducted the above surveys from 12 October to 30 October 2020 and from 5 July to 25 July 2021, and six and eight graduate students participated in the questionnaire data collection activities during these two survey periods, respectively. Although the questionnaires were conducted at the individual level, the sampling units were farm households. Therefore, one questionnaire was used for each farm unit [19]. The total number of questionnaires issued in the two surveys was 1583, and 1418 effective questionnaires were ultimately recovered, for an effective rate of 89.58%. After strict screening, 103 incomplete questionnaires were excluded, accounting for 6.51%. In addition, 62 farmers refused to answer, leading to a refusal rate of 3.91%. The total sample size was significantly larger than the minimum number of questionnaires (N = 384) determined by the error value of the presurvey questionnaire; therefore, the results could be supported by sufficient data.

The questionnaire consisted of three parts: (1) an importance preference assessment and accessibility perception assessment based on the Likert five-point scale; (2) indicators of the farmers' well-being, including objective indicators such as housing area and income level, as well as a subjective well-being assessment based on the SWLS and MA Well-Being Satisfaction Scale; (3) indicators of the farmers' capabilities, including the number of agricultural training sessions and off-farm training sessions they attend per year, the amount of agricultural machinery and transportation vehicles in their possession, and the number of close relatives and friends they have; and (4) the farmers' demographic attributes, including gender, age, and educational level. The socioeconomic characteristics of the farmers are shown in Table 1. Details of the questionnaire are given in Appendix A.

Table 1. Socioeconomic characteristics of the farmers in the study region.

All Farmers	Grouping	Number of Samples	Proportion/%
Gender	Male	883	62.27
	Female	535	37.73
Age (years)	<50	327	23.06
	50~59	426	30.04
	60~69	458	32.30
	≥70	207	14.60
Education	Uneducated	283	19.96
	Primary school	578	40.76
	Junior high school	396	27.93
	High school and above	161	11.35
Annual income per capita (CNY)	<3000	156	11.00
	3000~5999	194	13.68
	6000~8999	376	26.52
	9000~11,999	447	31.52
	≥12,000	245	17.28
Total		1418	100

2.3.1. Integrated Assessment of the Importance and Accessibility of ESs

The ES classification in this paper was based on the MA typology, as it is the most widely recognized ES classification system. Additionally, we referred to previous ES classifications in specific regions [19,31] and ultimately identified 11 ESs. Provisioning services included crops (a1 in the structural equation model of the variables shown below), fruits (a2), meats (a3), fuelwood (a4), fodder (a5), and wild food (a6); regulating services included soil conservation (a7), water conservation (a8), and pest control (a9); and cultural services included landscape aesthetics (a10) and recreation (a11). These ES types were fully acknowledged in our semi-structured interviews with local stakeholders in July 2019.

Supporting services were more consistent in meaning with regulation services and were not assessed given the efficiency of the assessment in this paper [40].

The questionnaire assessed two aspects of ESs, importance and accessibility, which are two important perspectives for understanding the contribution of ESs to well-being. Because the educational level of local farmers is generally low, a form of scoring and rating pictures was used in this paper; this approach has been used effectively in studies of ecologically vulnerable areas [15,30,31]. Prior to the evaluation, simplified images of each ES category were created, and respondents were given detailed information about the meaning of each image to ensure that they were well equipped to perform the scoring activity. During the evaluation, respondents organized the picture cards representing each category of ES according to a Likert scale (5 values). On this scale, 1 represented the least important or least accessible type of ES, and 5 represented the most important or most accessible ES. After this assessment, a semi-structured interview was conducted in which the respondents were asked to answer why they scored the pictures the way they did. The entire scoring activity and semi-structured interview took approximately 20 min.

The importance of different ESs reflects the differing preferences and needs of farmers for ESs but ignores the issue of the accessibility of these ESs and therefore does not effectively reflect the true contribution of ESs to farmers' well-being [50]. An integrated assessment of the importance and accessibility of ESs provides a useful perspective for understanding the true contribution of ESs to human well-being [21,22]. The importance and accessibility values were integrated into the ecosystem services importance–accessibility index (ESIA index) in this paper, in which a higher ESIA index indicated a higher level of a particular type of ES for the farmer and vice versa. The index formula was as follows:

$$ESIA_i = \sqrt{Im_i \times Ac_i} \quad (1)$$

where $ESIA_i$ is the importance–accessibility index of a class i ES and takes the value of [1,5], and Im_i and Ac_i are the importance and accessibility values of the class i ES, respectively, and take the value of [1,5].

2.3.2. Assessment of Farmers' Well-Being

Farmers' well-being is usually determined using a number of widely used evaluation indicators. Among the common frameworks of human well-being, human needs theory provides a generic list of human needs, and its unique perspective of multidimensional needs provides a scientific theoretical framework for human well-being assessment in poor areas [54,55]. In this paper, an index system for evaluating farmers' well-being was constructed based on human needs theory (Table 2). Human needs theory contains four needs dimensions and one subjective dimension, which represent farmers' objective and subjective well-being, respectively. Subsequently, factor and indicator layers were constructed under each dimension.

Basic needs are the primary measure of human well-being [56]. Basic needs provide a list of "necessities" that provide individuals with the basic elements for survival and development [57]. In this paper, basic needs were characterized into three elements: nutrition, energy, and housing. Economic needs are described as the degree to which individuals are satisfied with their possession of economic resources [58], with the aim of improving their standard of living rather than maintaining it. In this paper, economic needs were characterized into the adequacy and stability of income. Currently, annual per capita income remains the main indicator for characterizing farmers' well-being in economically poor areas [32]. Moreover, the adoption of diverse livelihood strategies by farmers is an effective way to reduce livelihood risks [59]. Social needs reflect the degree of people's demand for non-economic factors [56], and this paper focused on assessing farmers' leisure needs. Leisure needs represent the need for farmers to maintain satisfactory social interactions by developing connections with others in their leisure activities [60] and are a key component of social needs. Environmental needs are the extent to which farmers are satisfied that their surroundings and can support their survival and development [61],

and this paper focused on assessing the physical safety indicators that keep farmers free from physical harm. Farmers' subjective well-being refers to their satisfaction with their living conditions [4,44], which was characterized using the Satisfaction with Life Scale and the MA Well-Being Satisfaction Scale in this paper [11,61]. These two scales express the overall satisfaction and the sub-dimensional satisfaction aspects of subjective well-being, respectively, and this approach offers more complete expression of subjective well-being [19].

Table 2. Indicator system for assessing farmers' well-being based on human needs theory.

Dimensionality	Elements	Number	Indicator	Indicator Assignment
Basic needs	Nutrition	b1	Nutritional conditions	Consumption of meat, eggs, and milk/total household food consumption (%)
	Energy	b2	Energy fuels	Straw/fuelwood = 1, coal = 2, gas = 3, natural gas/electricity = 4
	Housing	b3	Housing area	Total house area/total household size (m^2)
Economic needs	Revenue	b4	Annual income per capita	Annual household income/total household size (million CNY)
	Livelihood Diversity	b5	Number of livelihood categories	Number/type of livelihoods that household members engage in
Social needs	Leisure needs	b6	Leisure time	Average time spent on leisure per day (h)
Environmental needs	Personal safety	b7	Environmental safety	Natural disasters in villages have little impact on their own personal safety (strongly disagree = 1, disagree = 2, neutral = 3, agree = 4, strongly agree = 5)
Subjective well-being	Life satisfaction	c1	Life satisfaction	Satisfaction with Life Scale (SWLS-5), taking values [5,35]
	MA satisfaction	c2	Revenue	Very dissatisfied = 1, dissatisfied = 2, neutral = 3, satisfied = 4, very satisfied = 5
			Material information	Very dissatisfied = 1, dissatisfied = 2, neutral = 3, satisfied = 4, very satisfied = 5
			Health	Very dissatisfied = 1, dissatisfied = 2, neutral = 3, satisfied = 4, very satisfied = 5
			Social relations	Very dissatisfied = 1, dissatisfied = 2, neutral = 3, satisfied = 4, very satisfied = 5
			Security	Very dissatisfied = 1, dissatisfied = 2, neutral = 3, satisfied = 4, very satisfied = 5
			Leisure	Very dissatisfied = 1, dissatisfied = 2, neutral = 3, satisfied = 4, very satisfied = 5

Note: The six indicators of the MA Well-Being Satisfaction Scale were used as observed variables in the structural equation model; the mean value of these six indicators was calculated as the value of MA satisfaction. "Number" represents the code name of the observed variable in the structural equation model.

2.3.3. Assessment of Farmers' Capabilities

Individual capabilities influence the type and amount of ESs acquired by farmers [35]. However, current researchers lack a comprehensive understanding of the types of capabilities possessed by farmers. Amartya Sen's theory of capabilities and Nussbaum's list of capabilities are relatively recognized in the academic community. Unfortunately, Sen did not provide a reference to the type of capabilities. Therefore, Nussbaum's list of capabilities helps us to clarify the composition of farmers' capabilities [62]. She considered basic capabilities to be those that individuals are born with, such as gender [63], and intrinsic capabilities to be the stable states of individuals' intelligence, health, and emotions. Based on this list of capabilities, one basic competency (gender) and three intrinsic capabilities (knowledge, skills, and health) were identified in this paper as components of farmers' capabilities. Additionally, a distinction was made between knowledge from education (i.e., educational attainment) and knowledge from local ecological knowledge (LEK), and we divided LEK into agricultural knowledge and ecological knowledge. We also separated skills into agricultural skills and employability skills, and health into physical health and

mental health [39,64]. In addition, certain external conditions of farmers' capabilities that are relevant to ES research were identified in this paper. For example, physical capital has been identified as farmer capabilities that enable people to benefit from Scottish forest ecosystems [34]. Relational networks are among the main farmer capabilities that enable Australian aboriginal people to obtain ESs from local ecosystems [38]. Therefore, physical capital and relational networks were included in the list of farmers' capabilities in this paper. In summary, 11 capabilities were selected by combining the list of capabilities and related studies. A quantitative approach with reference to the relevant indicators quantified these farmers' capabilities [15,22,39,44]. The components of the farmers' capabilities and the methods used to quantify those components are shown in Table 3.

Table 3. Composition of farmer capabilities.

Dimensionality	Elements	Indicators	Number	Variable Assignment
Basic capabilities	Gender	Gender	d1	Female = 0, male = 1
Intrinsic capabilities	Knowledge	Educational level	d2	Illiterate = 1, elementary = 2, middle school = 3, high school and above = 4
		Agricultural knowledge	d3	Farmers' level of understanding of local agricultural knowledge: 1 = not at all informed, 5 = very well informed
		Ecological knowledge	d4	Farmers' level of understanding of local ecological protection: 1 = not at all informed, 5 = very well informed
	Skills	Agricultural skills	d5	Number of agricultural skills training sessions attended (times/year)
		Employment skills	d6	Number of non-farm employment skills training sessions attended (times/year)
	Health	Physical health	d7	Self-rated health: very unhealthy = 1, very healthy = 5
		Mental health	d8	Mental Health Inventory (GHQ-12)
External conditions	Physical capital	Arable land area	d9	Household arable land area/total household size (mu)
		Agricultural machinery	d10	Number of types of agricultural machinery owned (rototiller, seeder, sprayer, grass cutter, tractor, motorcycle/three-wheeled motorcycle)
	Relationship network	Social level	d11	Number of close relatives and friends in the village (persons)

Note: "Number" represents the code name of the observed variable in the structural equation model.

2.3.4. Structural Equation Model

Structural equation modeling (SEM) is a multivariate statistical method that allows the exploration of logical relationships and complex influence paths with a limited sample size [5]. In this paper, SEM was used to determine the associations between influencing factors. SEM consists of a measurement model and a structural model. The measurement model was used to measure the relationships between latent variables and observed variables, and the structural model was used to reveal the relationship between each pair of latent variables. The model was as follows:

$$\begin{aligned} X &= \Lambda x\omega + \delta \\ Y &= \Lambda y\eta + \varepsilon \\ \eta &= \alpha\eta + \beta\omega + \gamma \end{aligned} \quad (2)$$

where X and Y are exogenous explicit variables and endogenous explicit variables, respectively; Λ_x is the factor loading of variable X on ω and Λ_y is the factor loading of variable Y on η; and δ and ε are the errors of variables X and Y, respectively. η is the endogenous latent variable, ω is the exogenous latent variable, α is the structural coefficient matrix of the endogenous latent variable, β is the structural coefficient matrix of the exogenous latent

variable and the endogenous latent variable, and γ is the residual of the structural equation. The initial model was established based on the research hypotheses (Figure 3). Farmers' capabilities were taken as the exogenous latent variable. The ESs, objective well-being, and subjective well-being were the endogenous latent variables, and the observed variables were used as the latent variables to construct a structural equation model containing 4 latent variables and 31 observed variables.

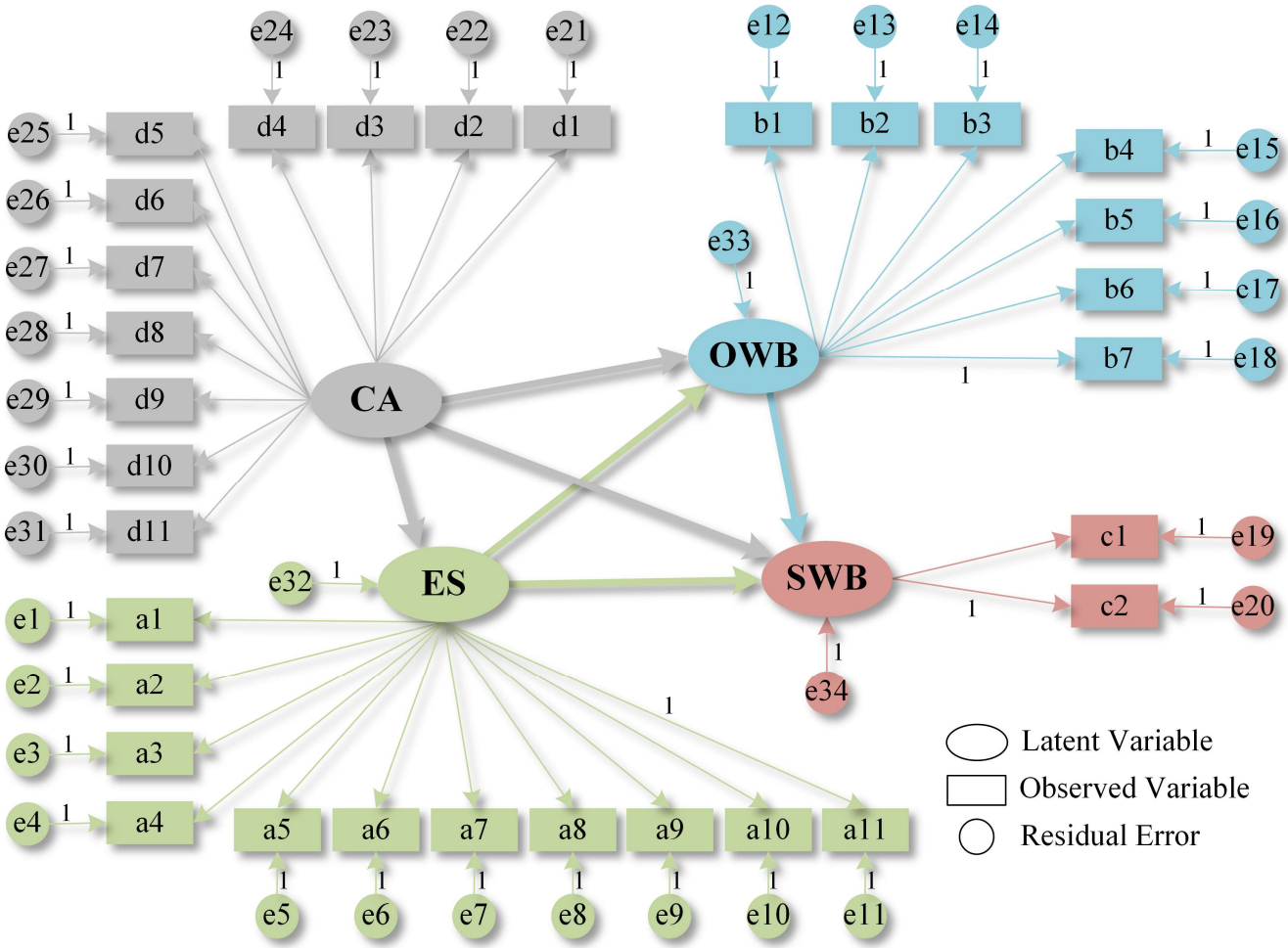

Figure 3. Initial conceptual model of the structural equation model.

3. Results

3.1. Levels of ESs, Human Well-Being, and Capabilities

3.1.1. Farmers' Levels of ES Use

The importance, accessibility, and ESIA indices of the ESs for the farmers are shown in Figure 4. Water conservation, crops, and pest control had the greatest importance, and these three variables were recognized by more farmers as being key ESs for traditional farming development. Landscape aesthetics and wild food were reported to be the least important ESs. Local farmers recognized the importance of cultural services, but some of them did not consider their relationship with their livelihoods to be direct, which is related to the immaterial nature of cultural services. The role of wild food as food and income declined as the household income increased.

The accessibility of wild food, pest control, and fruits was the highest. Farmers collect wild apricots and bitter greens in their leisure time, and these activities require the farmers to possess fewer capabilities. Moreover, the low importance of wild foods is related to their high accessibility, as they are readily available in the local area. The high accessibility of pest and disease control is related to the high efficiency of man-made

control measures in the region, as pest control measures such as pesticide application are straightforward and effective. Fruits were considered easy to obtain because they are more widely available in the region. Soil conservation, meats, and crops were reported as the least available ESs. Soil erosion is a common geological phenomenon in loess regions with hills and gullies, and although it can be mitigated through engineering measures, the overall accessibility of soil conservation is still low. The low accessibility of meats is related to the high input of farming, while the closure of mountains to grazing has also increased the cost of meat breeding, leading to a decrease in the accessibility of meats. Crops had the lowest accessibility because the local area is a rain-fed agricultural area, and the climate has been characterized by the occurrence of nine droughts in ten years, which has affected agricultural harvests, making crops difficult to access.

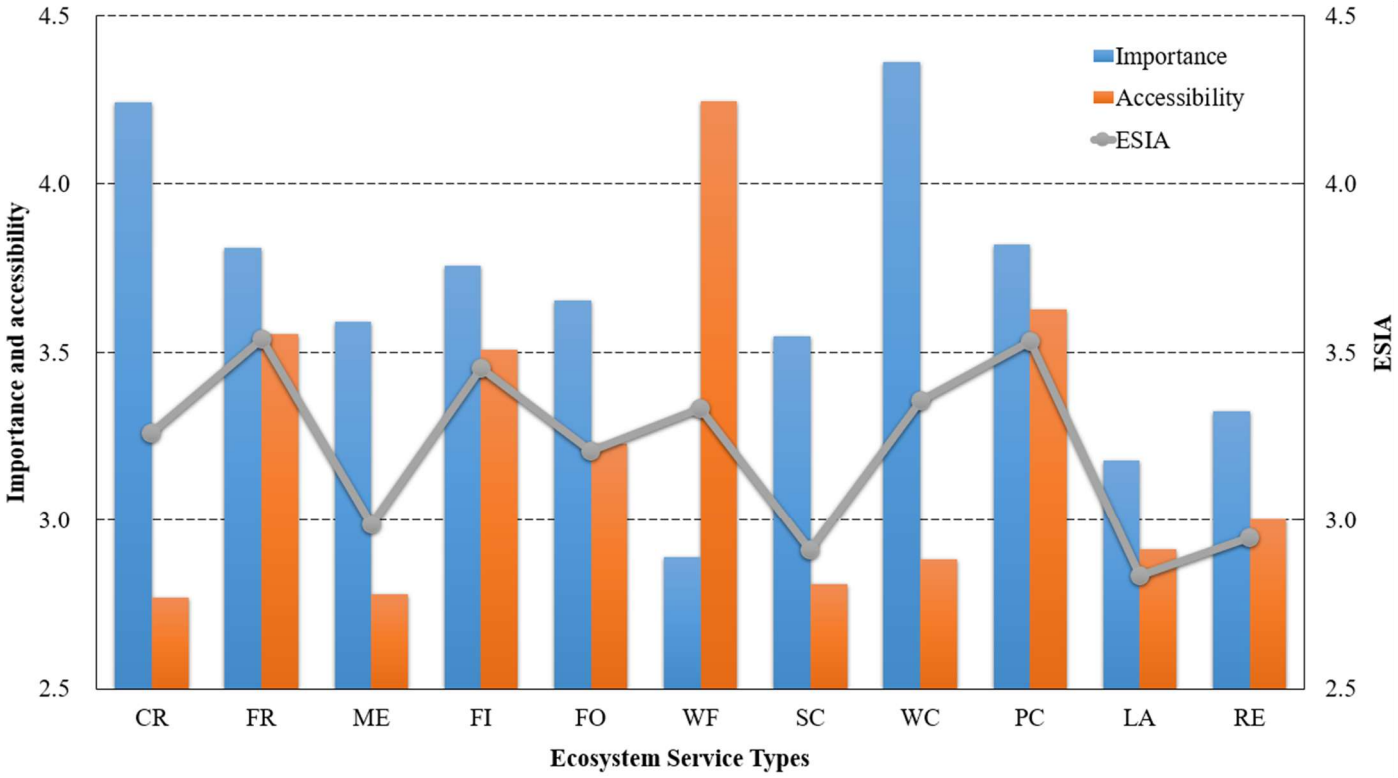

Figure 4. The importance, accessibility, and ESIA index values of ESs among farmers. Note: CR, crops; FR, fruits; ME, meats; FI, fuelwood; FO, fodder; WF, wild food; SC, soil conservation; WC, water conservation; PC, pest control; LA, landscape aesthetics; and RE, recreation.

The ESIA index of the farmers was calculated using Equation (1). Fruits, pest control, fuelwood, water conservation, and wild food were the five ES categories with the largest ESIA values, followed by crops and fodder. The ESIA index values of meat, recreation, soil conservation, and landscape aesthetics decreased in that order. Overall, the farmers reported higher levels for provisioning services, pest control, and water conservation and lower levels for their use of cultural services and soil conservation.

3.1.2. Farmers' Levels of Well-Being

The descriptive statistics for the farmers' objective well-being are shown in Table 4. Their consumption of meat, eggs, and milk reflects a higher level of food and nutritional needs, with an average value of 26.34% of the total food consumption. However, some farmers had nutritional indicators as low as 7% and poorly satisfied nutritional needs. The local farmers used fuelwood as their main energy source, and used fuelwood as an important material for cooking and heating; fewer farmers used electricity and natural gas. The annual per capita income of the farmers varied widely, and the work of income

underwriting needs to be further implemented and enforced. Farmers were engaged in approximately two types of livelihood activities. Farmers with more livelihoods were more capable of coping with natural and market risks, and their economic needs were met to a greater degree. The farmers' leisure time varied widely. Many farmers reported that they do not have time to engage in leisure activities because they farm every day and worry about their harvest, while older people admitted that they have more leisure time. Farmers' personal safety is generally affected by moisture-induced sinkholes and landforms during agricultural activities, as well as road collapses and landslides during transportation, all of which can reduce farmers' personal safety.

Table 4. The levels of farmers' objective well-being.

Dimensionality	Elements	Indicators (Unit)	Statistical Quantities			
			Average Value	Standard Deviation	Maximum Value	Minimum Value
Basic needs	Nutrition	Nutritional conditions (%)	26.34	10.19	65	7
	Energy	Energy fuels	1.85	1.23	4	1
	Housing	Housing area (m^2)	31.33	10.81	87.5	16.67
Economic needs	Revenue	Annual income per capita (million CNY)	0.97	0.65	6.5	0.17
	Livelihood diversity	Number of livelihood categories (types)	1.73	0.74	4	1
Social needs	Leisure needs	Leisure time (h/day)	2.85	1.76	8	1
Environmental needs	Personal safety	Environmental safety	3.53	1.41	5	1

The results regarding the farmers' perceived subjective well-being are shown in Figure 5. The farmers' life satisfaction scores ranged from 11 to 31 with a mean value of 19.96, which is slightly lower than the level of life satisfaction of Chinese residents reported 10 years ago (mean value = 20.32). This indicates that the life satisfaction of farmers in Mizhi County is still low. The results of the satisfaction perception analysis for the MA dimensions varied greatly. The farmers were more satisfied with their security, social relationships, and access to material resources. Among these factors, the farmers were most satisfied with security, but 8.11% of the respondents still reported uneasiness due to threats to their personal safety or uncertainty over property security and were most dissatisfied with their security status. This was followed by social relations, with 8.82% of the respondents reporting that they considered their neighborhood or family relations to be poor and that their social relations were the least satisfactory. The level of satisfaction associated with material access was high, but 5.71% of the respondents still showed the most dissatisfactory attitude toward their material access. The farmers were less satisfied with the income, health, and leisure dimensions. The farmers had high expectations of adequate income acquisition, but due to their own capabilities and external objective conditions such as market fluctuations and natural environmental disturbances, adequate income acquisition remains difficult, resulting in income satisfaction being the lowest. The lower health satisfaction is related to the onerous nature of agriculture and the aging of the sample population. The mean leisure satisfaction among the farmers was 3.44, and 35.19% of the respondents reported having the highest leisure satisfaction in the survey. Overall, the results regarding the farmers' perceptions of the six categories of subjective well-being indicators varied widely, with farmers being less satisfied with things that are difficult to obtain in real life, for example, indicators such as income and health, while farmers were overall more satisfied with things that are easier to access, for example, indicators such as safety and social relationships.

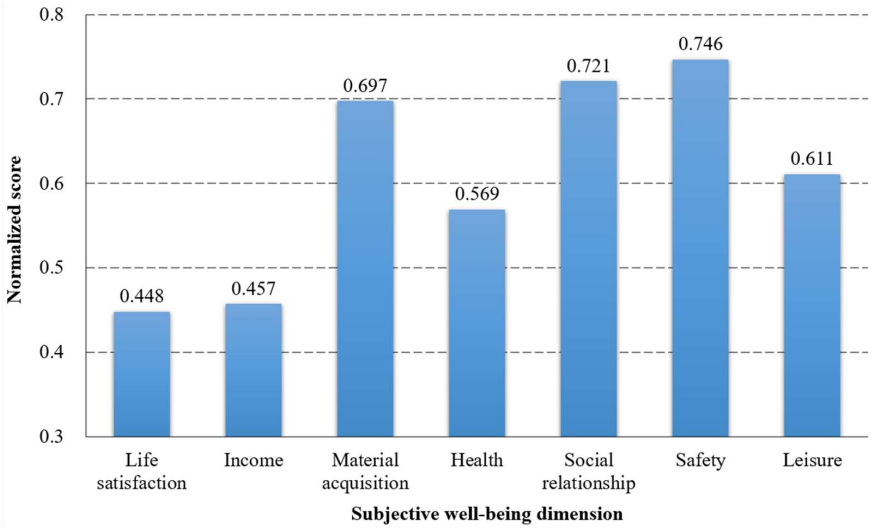

Figure 5. The levels of the farmers' subjective well-being.

3.1.3. Farmers' Levels of Capabilities

The farmers' capability levels are shown in Table 5. The farmers' agricultural knowledge was significantly greater than their ecological knowledge, and the farmers valued learning and perceiving agricultural knowledge for their farming. In contrast, the farmers' ecological knowledge was slightly weaker because they did not consider it to be very relevant to their livelihoods. The farmers reported participating in agricultural skills training approximately once a year, which improves their access to new agricultural skills. The farmers participated in employment skills training only 0.48 times/year, which is approximately 1/3 of their participation in agricultural skills training. The farmers had a moderate level of physical health, but 22.21% of the farmers still considered themselves to be extremely unhealthy and suffered from multiple chronic diseases for long periods. There were approximately three types of agricultural machinery holdings, among which three-wheeled motorcycles/motorcycles (71.16%), sprayers (65.94%), and seeders (60.51%) were the most common types of agricultural machinery, followed by rototillers (46.47%). Grass cutters and tractors were the rarest. The number of relatives and friends that each farmer had in their village was approximately four. A total of 11.07% of the farmers indicated that they did not have any relatives or good friends in their village; at the same time, 4.94% of the farmers had a good network, with 10 or more relatives/friends in their village.

Table 5. Farmer capability levels.

Capability Type	Dimensionality	Observed Variables	Grouping	Mean/Standard Deviation (or Ratio)
Basic capabilities	Gender	Gender	Male	62.27%
			Female	37.73%
Intrinsic capabilities	Knowledge	Educational level	Uneducated	19.96%
			Primary school	40.76%
			Junior high school	27.93%
			High school and above	11.35%
		Agricultural knowledge		3.91/1.15
		Ecological knowledge		3.23/1.43
	Skills	Agricultural skills		1.24/1.05
		Employment skills		0.48/0.59
	Health	Physical health		3.41/1.62
		Mental health		33.73/4.39
External conditions	Physical capital	Arable land area		2.90/1.53
		Agricultural machinery		3.12/2.51
	Relationship network	Social level		4.14/2.67

3.2. The Relationship between Capabilities, ESs, and Well-Being

3.2.1. Model Fit Index

Using AMOS 23.0 software, a first-order validation factor analysis was performed using maximum-likelihood estimation, and significant variables with nonsignificant factor loadings (*C.R.* < 1.96) were removed. After validation, the model was subjected to a secondary validation factor analysis after excluding the educational level (d2) variable, followed by a model fitness test based on the correction index (Table 6). After concatenating the model residuals one at a time, most of the fit indices improved and met the fitness criteria. Subsequently, the initial conceptual model with the nonsignificant effects of significant variables was run, and the fit of the model was corrected. Most of the fits of the modified structural model met the fit criteria, and the model fit was satisfactory for subsequent analyses. The corrected latent variable relationships are shown in Figure 6, and the observed variable path coefficients are shown in Table 7.

Table 6. Model fit indices.

Fitting Index	Reference Standard	Validation Factor Analysis	Modified Structural Model
χ^2/df	<2	1.788	1.552
GFI	>0.9 (>0.8 acceptable)	0.842	0.856
AGFI	>0.9 (>0.8 acceptable)	0.750	0.862
RMSEA	<0.05	0.033	0.031
NFI	>0.9 (>0.8 acceptable)	0.828	0.874
CFI	>0.9	0.874	0.917
IFI	>0.9	0.881	0.935
NNFI	>0.9 (>0.8 acceptable)	0.777	0.849
RFI	>0.9 (>0.8 acceptable)	0.811	0.817
PGFI	>0.5	0.642	0.653
PNFI	>0.5	0.657	0.660

Table 7. Path tests for the impacts of modified farm ecosystem services on human well-being.

Paths	Statistical Quantities			
	Coefficient	*S.E.*	*C.R.*	Significance
Farmers' capabilities → Gender	0.107	0.23	3.235	0.012
Farmers' capabilities → Agricultural knowledge	0.249	0.214	7.323	***
Farmers' capabilities → Ecological knowledge	0.191	0.223	4.786	***
Farmers' capabilities → Agricultural skills	0.480	0.254	9.235	***
Farmers' capabilities → Employment skills	0.124	0.156	3.827	***
Farmers' capabilities → Physical health	0.727	0.169	11.448	***
Farmers' capabilities → Mental health	0.701	0.282	11.012	***
Farmers' capabilities → Arable land area	0.226	0.201	6.55	***
Farmers' capabilities → Agricultural machinery	0.214	0.134	6.382	***
Farmers' capabilities → Social level	0.322	-	-	-
ES → Crops	0.645	0.041	23.234	***
ES → Fruits	0.577	0.041	19.888	***
ES → Meats	0.527	0.044	19.250	***
ES → Fuelwood	0.732	0.039	24.529	***
ES → Fodder	0.561	0.034	19.258	***
ES → Wild food	0.356	0.030	12.434	***
ES → Soil conservation	0.463	0.022	16.445	***
ES → Water conservation	0.597	0.04	20.453	***
ES → Pest control	0.519	0.035	17.235	***
ES → Landscape aesthetics	0.347	0.043	12.364	***
ES → Recreation	0.629	-	-	-

Table 7. *Cont.*

Paths	Statistical Quantities			
	Coefficient	***S.E.***	***C.R.***	**Significance**
Objective well-being → Nutrition	0.687	0.047	23.210	***
Objective well-being → Energy	0.344	0.012	13.288	***
Objective well-being → Housing	0.602	0.018	21.436	***
Objective well-being → Income	0.714	0.044	23.568	***
Objective well-being → Livelihood diversity	−0.174	0.028	−6.483	***
Objective well-being → Leisure needs	0.137	0.028	7.751	0.017
Objective well-being → Personal safety	0.264	-	-	-
Subjective well-being → Life satisfaction	0.918	0.02	30.434	***
Subjective well-being → MA satisfaction	0.804	-	-	-

Note: "-" indicates an observed variable with a default path of 1; "***" indicates $p < 0.001$.

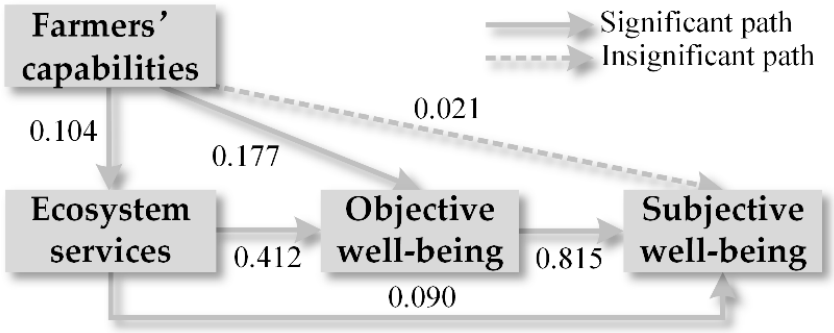

Figure 6. Path coefficients of influence between potential variables.

3.2.2. The Relationships between Potential Variables

Figure 6 shows the path coefficients of influence between potential variables. The direct effect of ESs on objective well-being was significant; the direct effect of ESs on subjective well-being was significant; and the direct effect of objective well-being on subjective well-being was significant. In terms of the latent variable path coefficients, the direct effect of ESs on objective well-being was significantly greater than their direct effect on subjective well-being. The direct effect of objective well-being on subjective well-being was the greatest, i.e., the relationships between the elements of human well-being were more pronounced. The direct effect of farmers' capabilities on ESs was significant, i.e., hypothesis H1 holds true; the direct effect of farmers' capabilities on their objective well-being was significant, i.e., hypothesis H2 holds true; and the direct effect of farmers' capabilities on their subjective well-being was not significant, i.e., hypothesis H3 does not hold true. In terms of the path coefficients of latent variables, the farmers' capabilities had the largest effect on their objective well-being, followed by ESs. The farmers' capabilities had a significant indirect impact on their objective well-being by influencing ESs (path coefficient: $0.104 \times 0.412 = 0.043$), i.e., hypothesis H4 holds true; the farmers' capabilities did not have a significant indirect impact on their subjective well-being by influencing ESs (path coefficient: $0.104 \times 0.090 = 0.009$), i.e., hypothesis H5 does not hold true; the farmers' capabilities had a significant indirect impact on their subjective well-being by influencing ESs and their objective well-being (path coefficient: $0.104 \times 0.412 \times 0.815 = 0.035$), i.e., hypothesis H6 holds true.

3.2.3. The Effects of the Observed Variables

The top five ranked ESs among the ES subtypes were selected as the key ES types affecting farmers' well-being (Table 7). It was found that fuelwood, crops, recreation, water conservation, and fruits were the key ES types affecting farmers' well-being (with a path coefficient greater than 0.57). The farmers recognized the contributions of some

provisioning, regulating, and cultural services to their well-being. At the same time, there was a difference in the extent to which the increase in the level of ESs affected the farmers' objective and subjective well-being. The three observed variables related to objective well-being with the greatest contributions were income, nutrition, and housing (with path coefficients greater than 0.6), which indicates that an increase in the level of ESs significantly contributed to the satisfaction of these three types of needs, which in turn improved the farmers' subjective well-being. Moreover, increases in ESs were also important for improving the energy access and personal security of the farmers.

From the perspective of the farmers' specific capabilities (Table 7), the farmers' capabilities had differential effects on both ESs and human well-being. All farmers' capabilities had positive relationships (positive coefficients) with ESs and human well-being, but there were significant differences in the magnitude of these effects. Among the farmers' capabilities, physical health, mental health, and agricultural skills were the key types of capabilities that influenced the farmers' ESs and their well-being (path coefficient > 0.4). Health was a core intrinsic capability, and the more physically healthy and mentally healthy a farmer was, the greater his or her capabilities were to improve his or her well-being through ESs. Moreover, agricultural skill competencies can contribute to the subjective and objective aspects of farmers' well-being by improving their access to ESs. In addition, the path coefficients of the farmers' capability types, such as social level and agricultural knowledge, were also higher, and all of these capabilities can have important effects on the improvement of farmers' well-being. In contrast, the gender, ecological knowledge, and employment skills capabilities had lower contributions to the farmers' access to ESs and their well-being, with path coefficients below 0.2, but the results for these three variables were still significant.

4. Discussion

4.1. The Need for Integrated Research on ESs and Human Well-Being

4.1.1. The ESIA Index Reflects the Actual Level of ES Use among Farmers

Most existing studies on ESs have focused only on the importance of ESs, that is, the demand for ESs from individuals, but little attention has been given to how available these in-demand ESs are [21,22,65]. Our study correlated the importance and accessibility of ESs, expressed through a unified index. We hypothesized that an ES is truly used by farmers only when it is both in need and relatively easy to access. Thus, the ESIA index expresses the actual level of ES use among farmers.

The results showed that the ESIA index constructed in this paper reflects the actual level of ES use among local farmers. The farmers valued provisioning services as well as regulating services related to agriculture (e.g., water conservation and pest control) because these ESs were relevant to their livelihoods and well-being [28]. However, among these important ESs, certain ESs are difficult to access. For example, crops and water conservation were of the greatest importance, but these two types of ESs were reported as being difficult to access. The local area is a rain-fed agricultural area covered by loess, which means that crops are often affected by drought. At the same time, drought affects the water storage function of the ecosystem, and heavy rainfall-induced loess erosion leads to low soil and water conservation in the ecosystem. These geographic factors make crops and water conservation difficult to access, thus reducing the actual contribution of these two types of ES to farmers' livelihoods (medium ESIA index). In contrast, fuelwood and pest control, although assessed as moderately important, were highly available, resulting in them having a higher ESIA index than crops and water conservation. That is, farmers use fuelwood and pest control at a higher level than crops and water conservation, even though the latter are of greater importance. This result is not apparent from previous studies that assessed only the importance of ESs. The ESIA index contains both the demand for a particular type of ES and how accessible that type of ES is to farmers. Therefore, this index can be used as a comprehensive indicator to understand the actual level of ES use by farmers by recognizing the level of demand and the farmers' access to ESs.

4.1.2. Subjective and Objective Well-Being Assessments Fully Reflect Farmers' Well-Being

A more complete characterization of human well-being is needed to elucidate the complex relationship between ESs and well-being [66]. Most existing studies on ESs and human well-being have assessed only a single dimension of well-being, such as objective well-being or subjective well-being [5,12], and subjective and objective well-being have rarely been investigated together [45], which does not allow the full picture of human well-being to be assessed and underestimates the actual effect of ESs on well-being. Therefore, this paper assessed both the objective and subjective well-being of farmers.

The results revealed different aspects of the objective and subjective well-being of farmers in Mizhi County. For example, the farmers' annual household income tended to be moderate, but the farmers' satisfaction with their income was the lowest among the six dimensions of the MA. On the one hand, it is clear that the farmers had high expectations regarding adequate income acquisition, but this information is more difficult to access from field research; on the other hand, social comparisons between low-income farmers and high-income farmers in the same village resulted in lower income satisfaction. The study results also revealed similar aspects of objective and subjective well-being outcomes for the farmers [67]. For example, the farmers' leisure time tended to be moderate, and, similarly, the farmers' leisure satisfaction tended to be moderate in the dimensions of the MA, reflecting consistency in the structure of both assessments. Overall, objective well-being is a realistic reflection of farmers' well-being, i.e., the realized outcome of well-being. Subjective well-being reflects farmers' perceptions of their current state of life, which is directly related to well-being. The combination of objective and subjective well-being is key to the integrity of representations of farmers' well-being while also providing a basis for subsequent research on the impact of capabilities on ESs and human well-being [26].

4.2. The Impact of Farmers' Capabilities on ESs and Their Well-Being

Individual capabilities are a key factor influencing farmers' preferences for and access to ESs [36]. Most previous studies have qualitatively explored the composition of capabilities [34,38]. In this paper, we expressed these competencies quantitatively in the context of Nussbaum's capabilities inventory [63], considering the characteristics of local farmers [22]. We identified 11 farmer capabilities that reflect, to the greatest extent possible, the capability types that farmers prefer and that provide them access to ESs. For example, the three elements of knowledge, skills, and health were decomposed into indicators within the intrinsic competency dimension [39,64]. Knowledge was further differentiated into education and LEK, and LEK was differentiated into agricultural knowledge and ecological knowledge to reflect the extent to which farmers had mastered different sets of knowledge. Moreover, we added some external condition indicators, including the farmers' material capital and relationship networks, which reflect some external conditions based on which farmers can realize their basic capabilities and intrinsic capabilities. These external conditions have been considered a type of capability for farmers in many studies [34,38]. For example, the combination of having a healthy body (intrinsic capabilities) and physical capital (extrinsic conditions) can increase the contribution of the food supply to a farmer's well-being.

The results indicate that the direct effect of farmers' capabilities on ESs and objective well-being is significant, while their direct effect on subjective well-being is not significant. Farmers' capabilities can affect their objective well-being through ESs, and can also affect their subjective well-being through ESs and objective well-being, but farmers' capabilities cannot affect subjective well-being through ESs. This result is interesting. This suggests that farmer capabilities have the most direct effect on ESs and objective well-being, while subjective well-being arises after ESs have been acquired and objective well-being needs have been met. Among the observed variables, physical health, mental health, and agricultural skills were identified as key farmer capabilities. Health is one of the most central capabilities, and farmers can enhance their physical fitness by exercising, engaging in leisure activities, and resting, which will also improve their psychological well-being. Having full access to ESs will improve farmers' well-being. Skills are inherent capabilities, and the

local government provides more agricultural skills training than other types of training for farmers. For example, the government sends many professional technicians to instruct farmers on how to improve crop yields through crop selection, planting inversions, and soil moisture conservation. These new types of agricultural farming education have increased farmers' capabilities to improve their well-being. Importantly, other capabilities, although with lower path coefficients, still contribute to farmers' well-being. Focusing on farmers' capabilities is critical for farmers in resource-dependent areas to better their access to ESs and improve their well-being, and can provide some insights into the relationship between ESs and human well-being.

4.3. Future Research

In future research, we can focus on several aspects. First, ESs and well-being were assessed through social perception methods, which are subjective, especially because respondent bias may exist. How to correct these survey errors is the key problem of social survey research and needs to be considered in future research. Second, the capability indicators considered in this paper do not fully reveal farmers' capabilities, and there are many capabilities that are difficult to express quantitatively. For example, in Nussbaum's list of capabilities, how capabilities such as control over the environment, imagination, and reflection are expressed quantitatively at the scale of individual farmers is a key issue in the study of ESs and human well-being from a competency perspective. Finally, multiple analytical methods need to be integrated. For example, canonical analyses can be used to illustrate complex relationships between ES indices and human well-being indices before a structural equation model is run.

5. Conclusions

The key issue addressed in this paper is the impact of farmers' capabilities on ESs and their well-being. To address this issue, we first constructed an importance–accessibility index for ESs, then assessed farmers' objective and subjective well-being. Finally, a system of indicators of farmers' capabilities was constructed to elucidate the impact of capabilities on ESs and well-being. The results showed that farmers reported the highest ES use levels for fruits, pest control, fuelwood, water conservation, and wild food. Crops, considered to be most important, did not contribute the most to the farmers' well-being because they were too difficult to access. There were some similarities and differences between the objective and subjective well-being of these farmers. For example, farmers with adequate leisure time reported higher leisure satisfaction and farmers with relatively adequate income levels reported the lowest income satisfaction. The direct effect of capabilities on ESs and objective well-being was significant, and the direct effect of capabilities on their subjective well-being was not significant. The farmers' capabilities had a significant indirect impact on their objective well-being by influencing ESs and did not have a significant indirect impact on their subjective well-being by influencing ESs; the capabilities had a significant indirect impact on their subjective well-being by influencing ESs and objective well-being. We identified physical health, mental health, and farming skills as key capability types that affect farmers' access to ESs and their well-being. Improving farmers' capabilities can enable them to more fully access ESs in agroecosystems to improve their well-being.

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Institutional Review Board Statement: This study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Institutional Review Board (or Ethics Committee) of Northwest University (NWU-IRB-202010011; 11 October 2020).

Informed Consent Statement: Informed consent was obtained from all of the subjects involved in this study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy restrictions.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Questionnaire structure and content.

Section I: Perceptions of the importance of ES and access to ES

The benefits provided by the local ecosystem were listed in the following pane. Please place a card representing ES type in the panel below. More stars means easy accessible or more important.

Perception of the Importance of ES		**Perception of Access to ES**	
Importance rating	ES types	Accessibility rating	ES types
★★★★★		★★★★★	
★★★★		★★★★	
★★★		★★★	
★★		★★	
★		★	

Questions:

1. Why do you think this ES is very important? Or not important?
2. Why do you think this ES is difficult to access? Or easily access?

ES Categories	**ES Types**
Provisioning services	**1.** Crops **2.** Fruits **3.** Meats **4.** Fuelwood **5.** Fodder **6.** Wild food
Regulating services	**7.** Soil conservation **8.** Water conservation **9.** Pest control
Cultural services	**10.** Landscape aesthetics **11.** Recreation

Section II: Human well-being assessment forms for farmers

1. Objective well-being

(1) How much does your family spend on meat, eggs and milk each year? How much do you spend on food each year?
(2) Which of the following energy materials are used in your home? (① fuelwood, ② coal, ③ gas, ④ natural gas/electricity)
(3) What is the total area of your house?
(4) How much is your annual household income?
(5) How many hours do you spend on leisure every day?
(6) Do you agree that natural disasters in villages have little impact on their personal safety? (① strongly disagree, ② disagree, ③ neutral, ④ agree, ⑤ strongly agree)

2. Subjective well-being

(1) SWLS-5 Scale (Scale 1–7 indicates strong disagreement to strong agreement)	
Most of the time my life is close to the life I want to live	① ② ③ ④ ⑤ ⑥ ⑦
My living conditions are very good	① ② ③ ④ ⑤ ⑥ ⑦
I am satisfied with the living conditions	① ② ③ ④ ⑤ ⑥ ⑦
I've got the most important thing I ever wanted in life	① ② ③ ④ ⑤ ⑥ ⑦
If I could live my life over again, I wouldn't change a thing, you know	① ② ③ ④ ⑤ ⑥ ⑦
(2) MEA Well-being Perception Scale	
Are you satisfied with your income level and spending power?	① Very dissatisfied ② Dissatisfied ③ Neutral ④ Satisfied ⑤ Very satisfied
Are you satisfied with the level of access to basic material information?	① Very dissatisfied ② Dissatisfied ③ Neutral ④ Satisfied ⑤ Very satisfied
Are you satisfied with your physical and mental health?	① Very dissatisfied ② Dissatisfied ③ Neutral ④ Satisfied ⑤ Very satisfied
Are you satisfied with family relationships and neighborhood relationships?	① Very dissatisfied ② Dissatisfied ③ Neutral ④ Satisfied ⑤ Very satisfied
Are you satisfied with your personal and property safety?	① Very dissatisfied ② Dissatisfied ③ Neutral ④ Satisfied ⑤ Very satisfied
Are you satisfied with leisure?	① Very dissatisfied ② Dissatisfied ③ Neutral ④ Satisfied ⑤ Very satisfied

Section III: Personal information of farmers

Name of village		Date recorded	
Gender	① Female ② Male	Age	
Family members		Cultivated area	
The number of relatives and close friends in your village			
Physical health	① Very unhealthy ② Unhealthy ③ Medium ④ Healthy ⑤ Very healthy		
Education level	① Illiteracy ② Primary school ③ Junior high school ④ High school and above		
Occupation	① Growers ② Livestock farmers ③ Multiple occupations ④ Government employees		
Means of transportation	① Cars ② Motorbikes ③ Three-wheeled motorcycles		
Agricultural machinery	① Rotary tillers ② Sprayers ③ Planters		
Do you know the local farming knowledge well?		① Strongly disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly agree	
Do you know the local ecological protection measures well?		① Strongly disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly agree	
You have recently been able to focus on what you are doing		① Strongly disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly agree	
You've been losing sleep worrying lately		① Strongly disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly agree	
You feel like you're doing something useful lately		① Strongly disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly agree	
You've felt capable of making decisions lately		① Strongly disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly agree	

You've been feeling a lot nervous lately	① Strongly disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly agree
You've been feeling like you can't overcome things lately	① Strongly disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly agree
You have recently been able to enjoy your daily activities	① Strongly disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly agree
You have recently been able to face the problems in your life	① Strongly disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly agree
You've been feeling unhappy or depressed lately	① Strongly disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly agree
You've lost confidence in yourself lately	① Strongly disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly agree
You've been thinking of yourself as worthless lately	① Strongly disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly agree
I'm happy you've been taking things into account	① Strongly disagree ② Disagree ③ Neutral ④ Agree ⑤ Strongly agree

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