

# Agricultural Land Suitability Assessment Based on GIS at the County Scale in Yibin, China

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**Abstract:** As agricultural land resources scarce, food security has emerged as a pressing global concern. Conducting a suitability assessment of agricultural land is crucial for agricultural resources and food security. To establish an evaluation index system, we incorporated land, water, climate, and society four dimensions of 16 indicators. And we incorporated Entropy Weight Method (EWM), an objective method, with integrated evaluation model to assess agricultural land suitability in Yibin. Based on actual agricultural production, areas of land of urban construction, rural settlement and mining and water are subtracted. The Findings found that agricultural land suitability in Yibin presented a significant spatial heterogeneity. Areas with suitability and relative suitability accounted for 57.61% of Yibin's land areas, which suggest Yibin has an abundance of agricultural land resources. Regions moderately suitable predominantly lie in the western and southern areas, covering 32.22% of the land area. Generally suitable areas accounted for 10.03% of Yinbin's land areas, spatial distribution of which is similar to moderately suitable regions. Moderately and generally areas are potential areas for agricultural production. And regions for unsuitable accounted for only 0.14% of land areas. Overall, results mentioned above indicate that Yibin's agricultural land resources are in good condition. Considered terrain and water sources, this study revealed that the spatial distribution of topography and annual precipitation in Yibin closely mirrored both suitable and relatively suitable regions.

**Keywords:** Yibin, Agricultural Land, Suitability Assessment, Food Security.

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## 1. Introduction

As the global population continues to grow, the intricacies and severity of agricultural land resource conflicts have intensified, food security concerns have emerged as a focal point of widespread international concern [1]. The challenge of achieving high yield and quality in grain production is currently a pressing issue. Addressing the challenge of producing high yield and superior quality food is a pressing issue that requires immediate attention [2]. The attainment of sustainable utilization of agricultural resources, with a particular emphasis on agricultural land resources, has emerged as a pivotal factor in addressing food security challenges across nations [3]. In this context, the juxtaposition of population and resources in developing nations exacerbates their pressure. Specifically, China's state accords significant attention to this issue at various policy levels. The No.1 Central Document for 2023 emphasized the necessity of exerting maximum efforts to enhance grain production, bolstering the protection and utilization control of cultivated land. This is pivotal in fostering sustainable agricultural development and investigating the correlation between grain production and the suitability degree of agricultural land. The State Council of China's No.1 Central Document for 2023 emphasizes the imperative to enhance grain production, bolster the protection and utilization control of cultivated land, thereby fostering sustainable agricultural development. Furthermore, it advocates for an exploration into the relationship between grain production and the suitability degree of agricultural land [4]. Municipal governments also implemented national spatial planning in alignment with the Guidelines for the Evaluation of National Land and Space Development Suitability Based on Resource Environmental Carrying Capacity (Trial) ("Dual-Evaluation" technical guideline). In the contemporary context of food security and

sustainable agricultural development, it is imperative to conduct a more nuanced assessment of urban agricultural land suitability, in order to provide a grounded scientific foundation for optimizing agricultural layouts and enhancing land use practices.

The study of agricultural land suitability assessment (ALSA) originated from the study of land suitability assessment (LSA) [5]. Different from LSA research, the object of ALSA research is on land designated for agricultural production. This involves a multitude of multidisciplinary decision-making factors aimed at optimizing the use of agricultural land resources [6]. In terms of the research subject, two modes exist for a comprehensive evaluation of agricultural land use [7-9], as well as single crops such as food crops [10, 11] and cash crops [12, 13]. The comprehensive evaluation mode emphasizes the assessment of regional characteristics and the development of a holistic evaluation model. In contrast, the single crop evaluation mode concentrates on the degree of synergy between a specific crop and agricultural land. In the terms of study area, administrative boundaries encompass multiple levels: countries [14], provinces [15, 16], cities [8, 9], and regions containing natural watersheds [7, 11], alluvial plains [17], basins [18], and agricultural industrial parks [19]. the methods applied to ALSA use mainly include Inverse Distance Weighted (IDW) method [11, 20] and Delphi method [21-23] used in indicator selection. Analytic Hierarchy Process [9, 24, 25], entropy method [7], geographical detector [26], the combination of subjective and objective methods [27] were used to calculate weights. Furthermore, the development of its decision-making layer is no longer confined to singular conditions such as soil, climate, and geography. Instead, there is a trend towards constructing an integrated evaluation system [28-30]. In general, the research perspective of ALSA is expanded and the content is constantly enriched. ALSA

aligns with practical considerations, there is a noticeable trend towards diminishing the scale of research areas, complemented by the objectivity of research methodologies and the comprehensiveness of the evaluation system's construction.

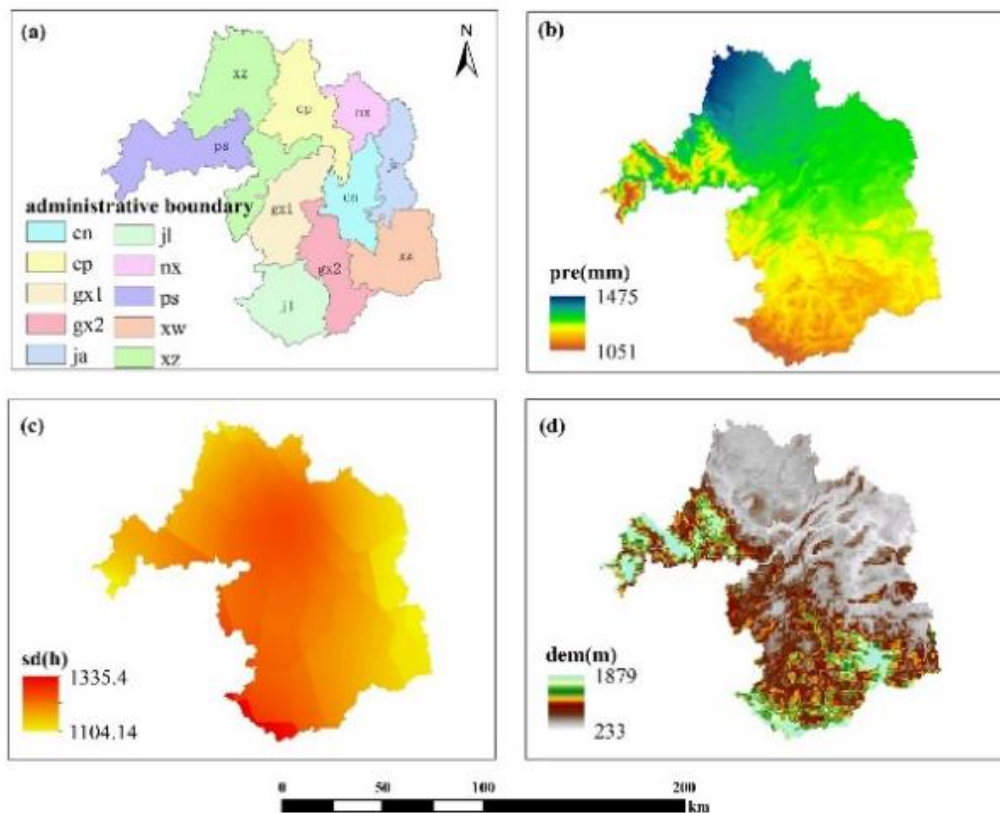
In summary, the majority of existing studies primarily focus on single crop suitability for agricultural land use. However, there is a noticeable lack of comprehensive evaluations oriented towards agricultural production suitability. As an important node city in the upper reaches of the Yangtze River, it is beneficial for Yibin to carry out a comprehensive evaluation of agricultural land suitability for overall agricultural land policy formulation. This study is based on the actual situation of Yibin, and will consider the land, water, climate resources for crop growth at the same time, and also incorporate social factors and management factors to jointly judge the suitability of agricultural land in the study area.

This study employs multi-source data to conduct an objective assessment of agricultural land suitability in Yibin, utilizing the entropy method. The primary objectives are to address two scientific issues: (1) Identifying the spatial distribution pattern of agricultural land suitability within Yibin; (2) Proposing targeted recommendations for agricultural production in Yibin.

## 2. Overview of the Research Area and Data Sources and Preprocessing

### 2.1. Study Area

Yibin is located between 28°~29°40' N, 103°20'~105°40' E, in the southeast of Sichuan Province, with Leshan and Zigong to the north and Luzhou to the east, which is at the junction of Sichuan, Yunnan and Guizhou provinces. The total area is 15167 km<sup>2</sup>, and there are 3 districts (Cuiping, Nanxi, Xuzhou), 7 counties (Jiangan, Changning, Gaoxian, Gongxian, Junlian, Xingwen, Pingshan) in the jurisdiction (Figure 1(a)). The climate is characterized by subtropical humid monsoon attributes, encompassing mild weather conditions, abundant heat, plentiful rainfall, an extended frost-free period, and minimal sunshine. The annual average precipitation was 1051-1475 mm (Figure 1(b)), and the annual sunshine duration was 1104.14-1335.4 h (Figure 1(c)). The elevation ranges from 233-1879 m (Figure 1(d)), with medium and low mountains and hills as the main landforms, and the overall terrain is high in the southwest and low in the northeast. There are mainly 4 soil types, yellow loam, purple soil, tidal soil and paddy soil, distributed with cultivated land, forest land, grassland and other land use types. In 2022, the area dedicated to grain crop sowing totaled 4364.73 km<sup>2</sup>. Yibin is abundant in crops such as rice, corn, and various food crops, as well as oil crops and tea, among other economic crops. The regional gross product value stands at 342.784 billion yuan, while the agricultural output value amounts to 4.272 billion yuan, a growth of 4.2% compared with 2021.



**Figure 1.** Overview of the study area. Note: xz: Xuzhou; cp: Cuiping; nx: Nanxi; ja: Jiangan; cn: Changning; ps: Pingshan; gx1: Gaoxian; gx2: Gongxian; jl: Junlian; xw: Xingwen; cn: Changning.

### 2.2. Data Sources and Preprocessing

The data used in this study mainly include the administrative boundaries of districts and counties, digital

elevation model (DEM), slope, organic matter, total nitrogen, total phosphorus, total potassium, soil ph, soil texture, soil erosion, annual precipitation, hydrological data, road data, global urban entity dataset, monthly precipitation,

standardized precipitation evaporation index (SPEI), potential evapotranspiration (PET), sunshine duration (SD), accumulated temperature (AT), land use (2020) (Table 1). Whereas, the annual precipitation total is obtained by summing monthly precipitation amounts. The slope and aspect data are obtained through surface analysis of DEM data in the ArcGIS 10.6. SPEI is derived from the ratio of potential evapotranspiration to annual precipitation total.

The monthly precipitation data for Yibin is sourced from the National Earth System Science Data Center, a part of the National Science and Technology Infrastructure Platform (<http://www.geodata.cn>). The global urban entity dataset is sourced from the National Earth System Science Data Sharing Service Platform, which is part of the National Science and Technology Infrastructure Platform, specifically from the Yangtze River Delta Scientific Data Center (<http://geodata.nnu.edu.cn>). The organic matter, total nitrogen, total phosphorus, total potassium, soil ph, and soil texture data are sourced from the Soil Center of the National Earth System Science Data Center, which is part of the National Science and Technology Infrastructure Platform (<http://soil.geodata.cn>). The administrative boundaries of districts and counties [31], DEM, and soil erosion data are sourced from the Data Center for Resources and Environmental Sciences, Chinese Academy of Sciences (<https://www.resdc.cn/data.aspx?DATAID=243>). The hydrological and road data are sourced from open-source datasets (Open Street Map, OSM, <https://www.openstreetmap.org/>). The SD and PET data are sourced from the Scientific Data Registration and Publishing System of the Geographic Remote Sensing Ecological Network ([www.gisrs.cn](http://www.gisrs.cn)). The AT data is sourced from the

publicly available dataset by Karger et al [32]. The land cover data is sourced from the dataset published by Yang Jie and Huang Xin from Wuhan University [33]. The Chinese ecosystem service function data is sourced from the Chinese Ecosystem Assessment and Ecological Security Database (<https://www.ecosystem.csdb.cn>).

### 3. Study Method

#### 3.1. Evaluation Ideas

According to actual agricultural production conditions, combined with current situation of agricultural production in Yibin, based on the principle of local conditions and data availability, this study selected lands, water, climate and society related indicators to construct an evaluation index system. The entropy weight method (EWM), which is an objective method that is not interfered by human factors, was used to calculate the indicators weights. Considering the actual conditions of farming, the agricultural production suitability was deducted for areas of land of urban construction, rural settlement and mining and water.

#### 3.2. Evaluation Ideas

The indicator selected is premise of constructing the evaluation index system. The indicator selection combined with the regional profile of Yibin [34], “double evaluation” guidelines, existing researches [35, 36] and considering the heterogeneity between indicators simultaneously, 16 indicators were selected from four dimensions of land, water, climate and society to construct the evaluation indicator system (Table 1).

**Table 1.** The construction of indicators system.

dimension	indicator	indicator type	indicator's meaning	indicator attribute
land	Elevation (m)	numerical value	altitude	negative (-)
	slope (°)	numerical value	flatness of cultivated land	negative (-)
	n	numerical value	proportion of soil nitrogen content	positive (+)
	p	numerical value	proportion of soil phosphorus content	positive (+)
	k	numerical value	proportion of soil potassium content	positive (+)
	soc	numerical value	proportion of soil organic matter	positive (+)
	soil ph	numerical value	soil ph	negative (-)
	soil erosion	type value	degree of soil erosion	positive (+)
	soil texture	type value	soil type	positive (+)
water	annual precipitation (mm)	numerical value	total accumulated precipitation within one year	positive (+)
	distance from water system (m)	numerical value	distance to nearest water source	negative (-)
	≥0°C accumulated temperature	numerical value	cumulative heat of all days with air temperature above 0 °C in one year	positive (+)
climate	sunlight duration (h)	numerical value	cumulative illumination time within 1 year	positive (+)
	spei	numerical value	ratio of potential evapotranspiration capacity and precipitation capacity	negative (-)
society	distance from road (m)	numerical value	distance from the national highway	negative (-)
	distance from city (m)	numerical value	distance between town center and surrounding areas	negative (-)

Wherein, land resource indicators contain elevation, slope, nitrogen, phosphorus, potassium, organic carbon, soil erosion, soil texture, soil ph. Elevation characterizes the surface undulation of the study area, which is closely related to the terrain required for agricultural production, accumulated

temperature and irrigation conditions, and also affects the mechanization and large-scale planting of modern agriculture. Generally speaking, the lower the terrain, the more favorable it will be for agricultural production. Slope will also affect surface undulation, and steep slopes are also prone to cause

soil erosion. In addition, it will also affect the light conditions of plants, and sunny slopes usually have more advantageous conditions for agricultural production. Nitrogen, phosphorus, potassium, organic carbon, soil texture are all related to the nutrient elements of soil and the fertility degree of soil. They are indispensable soil nutrients for plant production. Soil texture is related to soil silt content and soil permeability and water retention and fertilizer retention. The excessively sticky soil has strong water retention and fertilizer retention but does not have permeability and will produce wetting damage, which is not conducive to the production and development of plant root system [37]. The geographical location in Yibin does not yet exist freeze-thaw erosion and wind erosion, but Yibin is a confluence of three rivers, and under the influence of terrain, it is greatly affected by hydraulic erosion.

In terms of water resources, this study selected annual precipitation and water system. Annual precipitation determines the type of crop planting, and Yibin has abundant annual precipitation, which is conducive to the growth of water-loving crops. In addition, the spatial distribution of the water system affects the irrigation convenience of agricultural production, and long-distance water sources will bring greater irrigation costs, consuming a lot of manpower and material resources.

In terms of climatic conditions, the accumulation of temperature, sunshine duration, and drought index were selected in this study. The accumulation of temperature refers to the cumulative of all temperatures in seven years, which is also closely related to the type of crop planting. Sunshine duration provides light for crops to carry out photosynthesis, affecting the growth status of crops, and sufficient light usually brings better agricultural products. The drought index is the ratio of evaporation capacity to annual precipitation, which is a relatively comprehensive climate indicator.

In terms of social resources, the distance from road and the distance from city centers were selected. The distance from road is positively correlated with agricultural cultivation conditions, which facilitates material exchanges with other regions, indicating the smoothness of the circulation of agricultural products. Town centers are densely populated areas, and the closer the distance, the better the market location conditions, which is more conducive to the sales of agricultural products [38].

### 3.3. Entropy Weight Method

EWM is a typical calculation method with objectivity. The entropy value determines the degree of discretization, the spatial distribution of information content and index weight. There is a relationship between the smaller the entropy value, the greater the amount of information carried, and the greater the index weight. EWM has different table transformation processing methods for different types of indicators. Therefore, this study discriminated the attributes of the indicators to be evaluated, and identified elevation, slope, soil ph, distance from water source, distance from c, distance from road and drought index as negative indicators, while the rest were positive indicators (Table 1).

The specific calculation steps of the method are broken down into the following 4 steps:

Positive indicator:

$$Z'_{ij} = \left(0.999 \frac{Z_{ij} - \min Z_{ij}}{\max Z_{ij} - \min Z_{ij}}\right) + 0.001 \quad (1)$$

Negative indicator:

$$Z'_{ij} = \left(0.999 \frac{\max Z_{ij} - Z_{ij}}{\max Z_{ij} - \min Z_{ij}}\right) + 0.001 \quad (2)$$

where  $Z'_{ij}$  is the normalized value, which is the value of the  $j$  indicator under the  $i$  evaluation grid,  $\max Z_{ij}$  is the maximum value calculated by the partition statistical tool from the original data,  $\min Z_{ij}$  is the minimum value, and  $Z_{ij}$  represents the original data. The translation of 0.001 is to avoid division by zero in the calculation process from a mathematical point of view, avoiding that the calculation equation is meaningless.

(2) Calculate the specific gravity of the characteristic value

$$P_{ij} = \frac{Z'_{ij}}{\sum_{i=1}^n Z'_{ij}} \quad (3)$$

The formula is calculated by the grid calculator tool to calculate the weighting of the eigenvalues of the  $i$  grid under the  $j$  indicator, which aims to assign weights to each grid. The denominator part uses the partition statistics tool to calculate  $\sum_{i=1}^n Z'_{ij}$  for a single district, and the specific operation interface is to input the feature selection study area, field select county, value grid is  $Z'_{ij}$  corresponding grid data, and statistical type select sum.

1) Calculate n: The purpose is to count the sample size of each district, and the specific calculation steps are as follows:

Step 1: Using the standardized data to construct a new layer X, since the grid resolution is 1 km, the calculation formula is as follows:

$$X = Z'_{ij} * 0 + 1 \quad (4)$$

Step 2: Again, use the partition statistics tool, select the feature to study the area, the region field to select the district, and the statistical type to select SUM, calculate the layer of n value.

2) Calculation of k value using grid calculator based on the above steps

$$K = -\frac{1}{\ln n} \quad (5)$$

3) Calculate  $P_{ij} \ln P_{ij}$  using the grid calculator

4) The partition statistics tool is used to sum  $P_{ij} \ln P_{ij}$ , and the input element is also the research area file, the region field selects county statistical type selects SUM, and  $e_j$  is obtained.

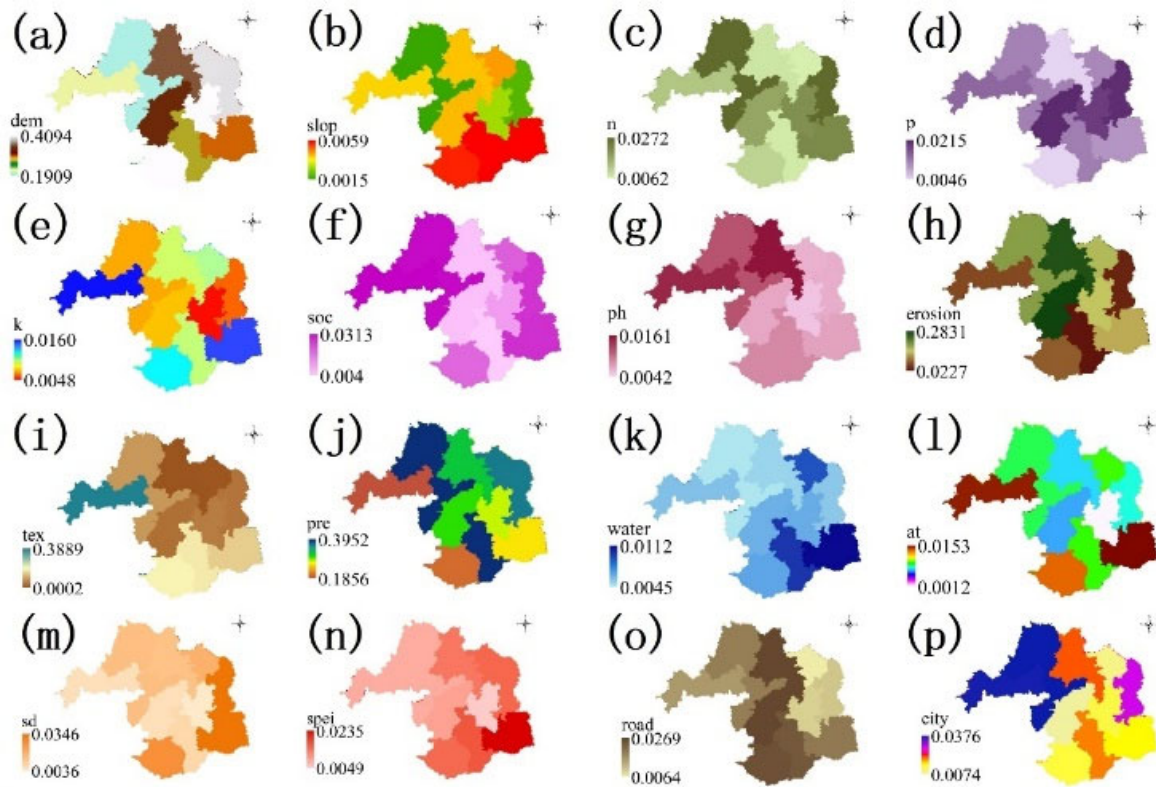
5) Using a grid calculator calculate  $e_j$ , the value of  $e_j$  ranges from [0.1].

$$e_j = -k \sum_{i=1}^n P_{ij} \ln (P_{ij}) \quad (6)$$

(4) Calculation of weights using a grid calculator

$$W_j = \frac{(1-e_j)}{\sum_{j=1}^n (1-e_j)} \quad (7)$$

Through the above calculation, this study calculated the weight results of all the evaluated indicators (Figure 2).



**Figure 2.** Weight of indicators. Note: dem: elevation; ph: soil ph; tex: soil texture; pre: annual precipitation; water: distance from water system; at: accumulated temperature; sd: sunlight duration; road: distance from road; city: distance from city;

### 3.4. Construction of Integrated Evaluation Model

Because a single index does not carry information of multiple indices, its suitability results cannot reflect the comprehensive profile of the study area, only the results of integrated evaluation carry all the information of the reference indicators and can reflect the comprehensive results of all grids in the study area, which is integrated by formula 8.

$$s_i = \sum_{j=1}^m w_j x'_{ij} \quad (8)$$

where  $s_i$  is the comprehensive evaluation index of the reference indicator,  $w_j$  is the weight of the  $j$  indicator, and  $x'_{ij}$  is the normalized indicator.

## 4. Results and Analysis

### 4.1. Analysis of Suitability Results

There are suitable, relatively suitable, moderately suitable, generally suitable and unsuitable in Yibin (Figure 3), the suitable areas account for 10.30% of the land area of Yibin (Table 2), which is mainly distributed in the eastern and northern areas of the study area, and sporadically distributed in the central and southwestern areas. The moderately suitable accounts for 47.31% of the land area of Yibin, which is concentrated and connected in the northern and central areas. The moderately suitable accounts for 32.22% of the land area of Yibin, which is mainly distributed in the southern and western areas, and intersects with the moderately suitable level in the central area. The generally suitable accounts for 10.03% of the land area of Yibin, and the spatial distribution pattern is roughly equivalent to that of the moderately suitable.

The unsuitable areas accounts for 0.14% of the land area of Yibin, with a small area and no obvious spatial distribution.

From the county scale, the suitability status of each district is significantly different. Among them, the suitability status of agricultural land in Xuzhou and Changning is the best, with suitable and moderately suitable areas accounting for most areas of their respective districts, and regions with moderate and lower are less. The area of moderate and lower in Xuzhou is mainly distributed in southern and western regions, while the area of moderately suitable and above is concentrated in the region. The area of moderate and lower in Changning is mainly distributed in the southern region, and the area of moderately suitable and above is widely distributed in the central and northern regions of this county.

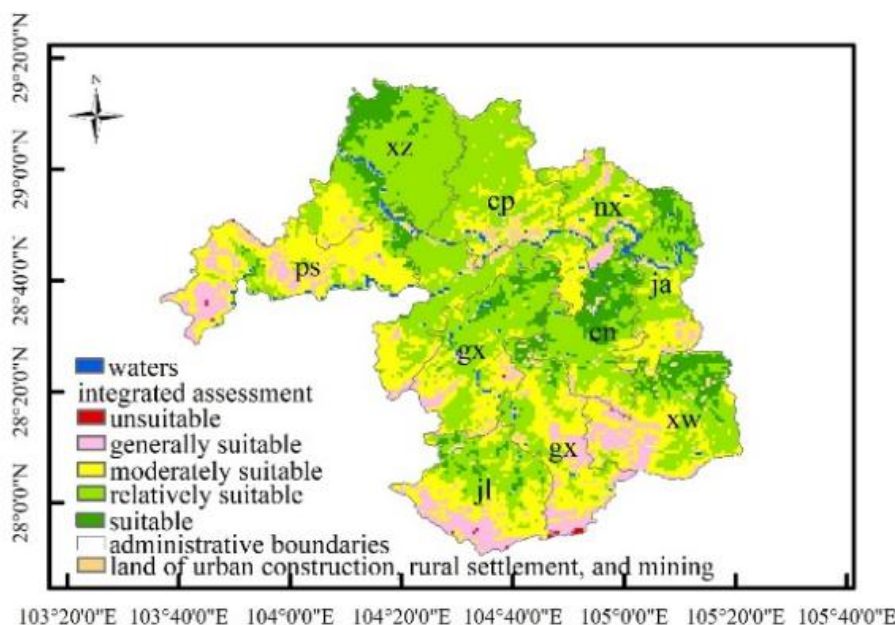
The suitability results of Pingshan and Gongxian are the least ideal. The areas of moderate suitability and general suitability are large in scale, distributed over their respective county ranges, the areas of relative suitability and suitability are small, but also relatively concentrated. Cuiping has only relative and moderate suitability, the comparative suitability is mainly distributed in the north, the moderate suitability intersects with the relative suitability in the middle and central regions. The relative suitability and moderate suitability of Nanxi are intersected in a strip shape, the area of the two grades is not much different, and this area is small, which is a general ideal area for agricultural production. Jiangan has a relative suitability roughly distributed in the north, general suitability and moderate suitability roughly distributed in the south, the area of the two grades is also not much different, which is a general ideal area for agricultural production. Xingwen and Junlian have large administrative region areas, among them, the difference in suitability between the east and west sides of Xingwen is obvious, the east side is dominated by relative suitability or above, the west side is dominated by

moderate suitability or below, Junlian has obvious differences in spatial distribution of suitability with Xingwen, the north side is dominated by areas of relative suitability or above, the

south side is dominated by areas of moderate suitability or below.

**Table 2.** Area distribution of different suitability levels by district and county.

district/cou nty	unsuitable		generally suitable		moderately suitable		relatively suitable		suitable		total area (km <sup>2</sup> )
	area (km <sup>2</sup> )	ratio (%)	area (km <sup>2</sup> )	ratio (%)	area (km <sup>2</sup> )	ratio (%)	area (km <sup>2</sup> )	ratio (%)	area (km <sup>2</sup> )	ratio (%)	
cp		0.00	21	1.32	509	32.09	1051	66.27	5	0.32	1586
gx	1	0.07	101	6.82	429	28.95	805	54.32	146	9.85	1482
gx	10	0.79	250	19.83	567	44.96	363	28.79	71	5.63	1261
ja		0.00	38	3.96	278	28.99	500	52.14	143	14.91	959
nx		0.00	78	10.26	260	34.21	415	54.61	7	0.92	760
ps	4	0.24	368	22.12	964	57.93	242	14.54	86	5.17	1664
xw	1	0.06	242	15.69	489	31.21	551	35.73	259	16.80	1542
xz		0.00	56	1.96	531	18.63	1926	67.58	337	11.82	2850
jl	4	0.29	282	20.17	531	37.98	489	34.98	92	6.58	1398
cn		0.00	29	2.62	149	13.46	570	51.49	359	32.43	1107
sum	20	0.14	1465	10.03	4707	32.22	6912	47.31	1505	10.30	14609



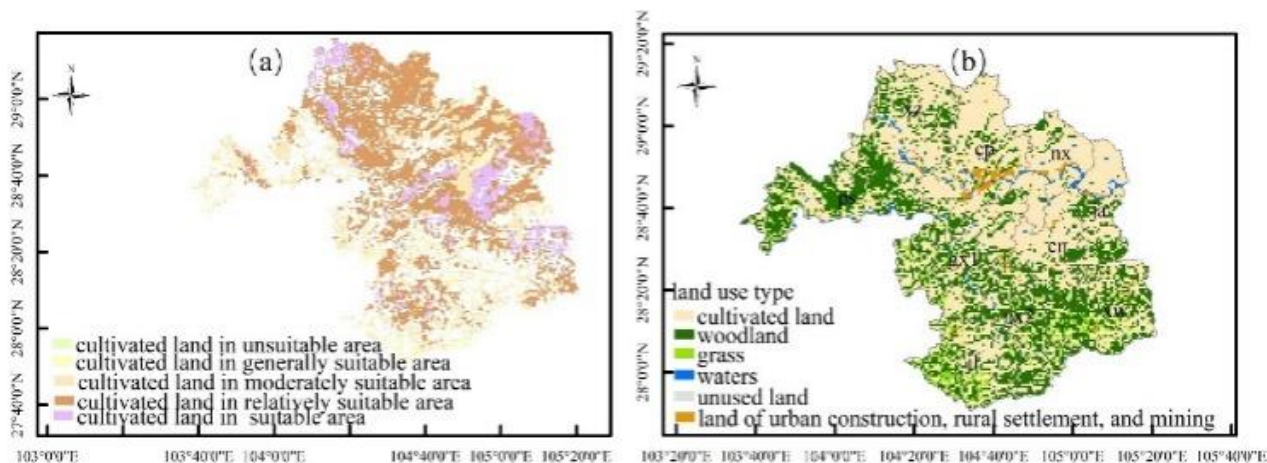
**Figure 3.** The result of suitability assessment. Note: xz: Xuzhou; cp: Cuiping; nx: Nanxi; ja: Jiangan; cn: Changning; ps: Pingshan; gx1: Gaoxian; gx2: Gongxian; jl: Junlian; xw: Xingwen; cn: Changning.

#### 4.2. Evaluation Results and Cross-Validation of Cultivated Land

This study further cross-validated the results of agricultural land suitability evaluation with the current status data of cultivated land in Yibin. The cultivated land data (Figure 4(b)) was extracted from the data of land use status, and it was superimposed with the suitability evaluation results (Figure 4(a)). It is shown that the cultivated area of Yibin is 9034 km<sup>2</sup>. Among them, the cultivated area distributed in the suitable area is 1161 km<sup>2</sup>, accounting for 12.91% of the total cultivated area, which is concentrated in the eastern and northern areas of Yibin, mainly in Changning, Xingwen and Xuzhou. The area of comparison suitable area is 5067 km<sup>2</sup>, accounting for 56.09% of the total cultivated area, which is widely distributed in all areas of Yibin, mainly in the east of Xingwen, Cuiping, Nanxi, Gaoxian, north of Junlian and Jiangan. The area of cultivated land under relatively suitable and suitable

area has 69% of the area as current cultivated land, which indicates that the cultivated land situation in Yibin is good.

The cultivated land area of moderate suitability is 2321 km<sup>2</sup>, accounting for 25.69% of the cultivated land area in Yibin, which is mainly distributed in Cuiping and Nanxi, and sporadically distributed in other districts and counties. The area of general suitability is 476 km<sup>2</sup>, accounting for 5.27% of the cultivated land area in Yibin, which is sporadically distributed in various districts and counties. Moderate suitability and general suitability are potential areas for agricultural production, and about 31% of the area in Yibin is a potential area with sufficient reserve resources for cultivated land. General suitability is not theoretically an ideal area for agricultural production, but it only accounts for 0.04% of the cultivated land area in Yibin, which has little impact on agricultural production in Yibin. Based on the above analysis, Yibin has good cultivated land resources.



**Figure 4.** Cultivated land with various suitability levels and land use types. (a) Cultivated land with various suitability levels. (b) Land use type. Note: xz: Xuzhou; cp: Cuiping; nx: Nanxi; ja: Jiangan; cn: Changning; ps: Pingshan; gx1: Gaoxian; gx2: Gongxian; jl: Junlian; xw: Xingwen; cn: Changning.

## 5. Conclusion and Suggestion

This study uses soil, water source, climate and social factors to construct the evaluation index system, using a method combining Geographic Information System (GIS) and EWM. The suitability of agricultural land in Yibin is explored, aiming at analyzing the spatial distribution pattern of agricultural bravely suitability in Yibin and its differences between regions. This study mainly obtains the following conclusions:

(1) The suitability of agricultural land in Yibin has obvious spatial heterogeneity. The suitability is mainly distributed in the northeastern and northern areas of Yibin, mainly distributed in Changning, north of Xingwen and Jiangan, north and west of Xuzhou, east of Pingshan, northeast of Gaoxian. Relatively suitable areas are widely distributed in all districts and counties of Yibin, mainly distributed in Xuzhou, Cuiping, Jiangan, Gaoxian, Changning, Nanxi, Central Xingwen and Northern Junlian. Moderate suitability areas are mainly distributed in the lowlands of southern and western Yibin, i.e. south of Junlian, Gongxian, western of Xingwen, whole area of Pingshan and south of Jiangan. The spatial distribution pattern of general suitability is similar to that of moderate suitability. Regions with unsuitable is small.

(2) Yibin is dominated by low mountains and hills, and the overall terrain is relatively low, except for the western and southern areas where the terrain is slightly higher, the rest of the area is flat. It is consistent with the spatial distribution pattern of suitable and relatively suitable. In addition, the annual precipitation in the study area is abundant, which is consistent with the spatial distribution pattern of elevation in this area, mainly distributed in the areas of Xuzhou, Cuiping and Nanxi, which are ideal areas for agricultural production. This part of the area can make full use of the topographical advantages and rich water resources conditions, continuously strengthen the mechanized planting, and in the low mountain hilly areas it can reduce landslides and strengthen the planting of economic crops such as tea leaves.

(3) The high-altitude areas of Xingwen, Pingshan, Gong and Junlian have abundant sunshine, which can make full use of the advantages of climate and terrain to develop cash crops such as fruit trees. The diurnal temperature difference can increase the sugar content of fruits and improve the quality of agricultural products. At the same time, it is possible to

develop an understory industry, plant with other legume crops or develop animal husbandry, which can not only reduce ground weed coverage but also provide nutrients for fruit trees, which is a common agricultural production mode in Yibin.

The suitability evaluation of agricultural land is subject to many factors, and due to the limitation of data availability, there are some deficiencies in this study that need to be further improved: (1) The occurrence of disaster events was not considered; (2) The impact of factor interactions on the evaluation results was not considered, which will be further improved in future studies.

## Abbreviations

GIS: Geographic Information System;  
 IDW: Inverse Distance Weighted;  
 ALSA: Agricultural Land Suitability Assessment;  
 LSA: Land Suitability Assessment;  
 EWM: Entropy Weight Method;  
 DEM: Digital Elevation Model;  
 SPEI: Standardized Precipitation Evaporation Index;  
 PET: Potential Evapotranspiration;  
 SD: Sunshine Duration;  
 AT: Accumulated Temperature.

## Author Contributions

Xu Juan: Data curation, Software, Funding acquisition, Validation, Methodology, Writing – original draft, Writing – review & editing

Jiao Cuicui: Resources, Supervision

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## Conflicts of Interest

The authors declare no conflicts of interest.

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