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The Evaluation of Wheat Planting Suitability in Zhenping County, Henan Province Based on GIS and RS

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Abstract

Wheat, as an important food crop, has a significant impact on regional and national food security. Nanyang is one of the main wheat production areas, therefore, monitoring the current situation of wheat cultivation and planning planting areas is of great significance. Firstly, Geographic Information System (GIS) technology and the Analytic Hierarchy Process (AHP) were used to partition the land suitability in Zhenping County, and then a suitability level map for wheat planting was created through suitability evaluation indicators. Then, through Remote Sensing (RS) technology, the actual planting situation of wheat in 2021 and the suitability area were analyzed in spatial analysis. The results show that in 2021, the wheat planting area accounted for 53.72% of the total arable land area in the town, and planting in highly suitable areas accounted for 84.73% of the total area. By analyzing the current situation, summarizing the rationality of local agricultural planting, we can provide a scientific basis for future grain crop planting, which is of great significance for optimizing agricultural production layout and improving agricultural production efficiency.

KEYWORD *Winter wheat Remote Sensing(RS) Geographic Information System(GIS)、Analytic Hierarchy Process(AHP); Object-oriented classification method (OOC)*

1. Introduction

As a populous country, China has a high demand for food, so food security is very important for the country. Wheat is one of the most important food crops in China, and the planting scale and yield of wheat are of great significance for food security and social stability. Therefore, the suitability of wheat planting on land has strong practical significance. Land suitability evaluation is widely used in the rational evaluation of various crops. If a systematic evaluation can be conducted based on the actual situation of wheat planting and its suitability, and geographic information system (GIS) technology can be used to comprehensively analyze the rationality of regional wheat planting, the degree of land use and production level can be improved.

Evaluating the suitability of a certain crop's planting area has long been a popular research issues. For example, Gu et al. (2022) evaluated the suitability of corn planting in Pujiang County and found that excellent corn planting land accounted for 51% of the total dry land area. Yuan et al. (2017) used GIS technology to analyze the ecological suitability of wheat in Shangnan County and constructed systematic data on suitable wheat planting areas. Li et al. (2020) analyzed the apple planting in Tianshui City and found that the results were consistent with the actual planting areas in Tianshui City. Qi et al. (2022) evaluated the suitability of apple planting in Zhengning County through indicators such as soil nutrients, providing a scientific basis for local apple planting.

In addition, to analyze the rationality of crop planting in a certain area, in addition to evaluating the suitability of local planting, it is also considered to extract actual data on local crop planting. There are also some precedent studies in this section. For example, by using RS technology to extract the planting area of wheat in Xinjiang, it is believed that high-resolution images can improve the accuracy of crop extraction (Tian et al., 2018). The analysis of wheat rapid recognition using data from Gaofen-2 suggests that RS images have great potential for application in the agricultural field (Guo et al., 2018). In addition, the area of winter wheat planting was extracted from RS images in different periods. The synthesized images obtained using RS synthesis methods of different periods can enhance the spectral information of winter wheat and other features, which is conducive to high-precision extraction of planting areas (Wang et al., 2014).

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Wheat is the main grain crop in northern China, consisting of approximately 70% carbohydrates, 12% protein, 1% fat, minerals such as calcium, iron, zinc, magnesium, vitamins, and abundant dietary fiber. The planting area of wheat is very extensive, but its growth also has certain environmental requirements, including soil physical and chemical properties, altitude, climate, soil nutrients, and so on. The suitable soil pH for its growth is between 6.0 and 7.5, and high or low pH values can affect its growth and development. The suitable soil nutrient content includes certain requirements for total nitrogen, total phosphorus, and total potassium. Therefore, the research and planning of suitable planting areas have great significance for the production efficiency of crops.

The growth of winter wheat is divided into nine stages: emergence, tillering, overwintering, turning green, jointing, booting, heading, flowering, and maturity. Different growth stages have different characteristics. Generally speaking, winter wheat has a lower reflectivity in the visible light range and a higher reflectivity in the near-infrared range, exhibiting a significant red-edge effect. The vegetation index (VI) time series spectrum of winter wheat can reflect its phenological characteristics, such as the sowing period, jointing period, heading period, maturity period, etc. (Yang, 2019; Tian, 2019). Winter wheat and other crops (such as rapeseed, garlic, etc.) may have the problem of foreign objects sharing the same spectrum in optical images, which means they have similar spectral and temporal vegetation index features. In this case, the structural information of microwave images can be used to distinguish those (Yang et al., 2015). Generally speaking, winter wheat seedlings emerge around one week after sowing, and Normalized Difference Vegetation Index (NDVI) shows a gradually increasing trend. By December, when tillering is strong, the NDVI curve shows the first peak and then enters the overwintering period. The NDVI shows a downward trend. It begins to turn green in mid-February of the following year, and NDVI increases accordingly. Heading begins in late April, reaching the second NDVI peak. After ripening and harvesting, NDVI rapidly decreases. The NDVI time series curve of winter wheat has a characteristic of two peaks and one valley, which is a relatively rare feature of other vegetation (Liu et al, 2017; Wang et al., 2014).

This study takes Zhenping County, Nanyang City, as the study area and uses ArcGIS to combine soil nutrients, physicochemical properties, and site conditions to calculate the factor weights between various indicators to evaluate the suitability of wheat planting. Further, use RS satellite images to extract the range and area of local winter wheat cultivation, and conduct cross-statistical analysis to evaluate its rationality.

2. STUDY AREA AND DATA SOURCES

2.1. *Study Area*

Zhenping County is located in the southern part of Henan Province (longitude 110 ° 58 '~112 ° 25' E, latitude 32 ° 51 '~33 ° 21' N), located in the hinterland of the Central Plains, with a total area of 1494km² (Figure 1). The northern part of Zhenping is mountainous, while the southern part is plain, showing an overall trend of tilting from north to south. The elevation difference between the highest and lowest points within the territory is over a thousand meters. Zhenping is located in the transitional area between subtropical and warm temperate zones in China, with an average annual sunshine of 2013.2 hours and an average annual temperature of 15.1 ℃. The average annual frost-free period is 233.3 days, with an average annual rainfall of 761 millimeters. Due to being located in a transitional area, the characteristics of the transition are obvious, with distinct four seasons, suitable rainfall, and a longer frost-free period, making it suitable for agricultural development. The local grain planting area is 1.477 million mu, with a total grain output of 0.526 million tons. It is one of the important grain production areas and also a major agricultural county, and the development of the agricultural industry is an important part of the local area.

Zhenping County has 3 sub-districts, 11 towns, and 8 townships, including Neyang Street, Xuefeng Street, Yudu Street, Shifosi Town, Chaopi Town, Jiasong Town, Houji Town, Laozhuang Town, Luyi Town, Zheshan Town, Gaoqiu Town, Qutun Town, Zaoyuan Town, Yangying Town, Liuquanpu Township, Erlong Township, Wanggang Township, Mazhuang Township, Zhanglin Township, Anziying Township, Pengying Township, and Guozhuang Hui Township. These towns and streets each have different characteristics and development priorities. Among them, Neyang Street is the location of the Zhenping County Government.

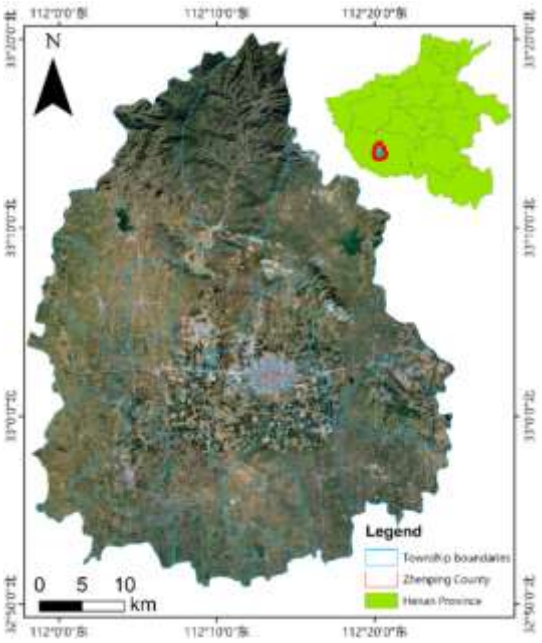

Figure 1 Overview of Zhenping County, Nanyang City, Henan Province

2.2. *Data Collection*

The basic data for the study include:

1. The data related to soil nitrogen, phosphorus, potassium content, soil organic matter, and soil pH value are sourced from the Chinese Soil Organic Matter Dataset (Dai and Shangguan, 2019;

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Shangguan et al., 2013)

2. The altitude and slope data of the region, as well as the DEM data of Zhenping County, are derived from ASTER GDEM 30M resolution digital elevation data on the Geospatial Data Cloud Platform (https://www.gscloud.cn/home).
3. Land use type data, derived from a dataset generated by the ESRI Impact Observatory for the Dynamic World project, developed by the National Geographic Society in collaboration with Google and the World Resources Institute (Karra, Kontgis, et al., 2021).
4. RS data is derived from LANDSAT-8 satellite images in April 2021 (https://www.gscloud.cn/home).

3. METHODOLOGY

This study used soil-related data, the DEM of Zhenping County, and RS images to perform interpolation analysis of terrain and soil and establish a suitability grading evaluation for arable land. At the same time, the land use profile of wheat cultivation is obtained through the classification and processing of RS images. After conducting cross-statistical analysis on the two, statistics on the wheat planting area and the planting overview of the suitable areas were generated, respectively (Figure 2) (Peng et al., 2009 ; Feietal., 2010 ; Zhang et al., 2014). The relevant methods are briefly described as follows:

1. Determine the evaluation factors for wheat cultivation. Considering the local land use characteristics, combined with the actual situation, using expert experience as indicators, and referring to relevant literature and the characteristics of wheat growth, seven factors, including Elevation, Slope, pH value, and Soil Organic Matter(SOM), total nitrogen (TN), available phosphorus (A-P), and available potassium (A-K), were selected as evaluation factors.
2. Using ArcGIS for slope analysis and processing of DEM data; and using interpolation analysis to obtain grid data within a certain element range for point data values related to nitrogen, phosphorus, and potassium.
3. Process the obtained data through ArcGIS, convert it into a raster file dataset with the same coordinates, and prepare for overlay analysis. Setting grading standards for different factors based on relevant national criteria and other papers as references. Process the raster data of each factor according to grading criteria.
4. Based on the weights calculated by AHP, use a raster calculator to obtain the suitability level map of cultivated land.
5. Preprocess RS image data, fuse images to improve resolution and use Object-oriented classification method (OOC) methods to extract the planting range of wheat in 2021.
6. Overlay the suitability level map of cultivated land with the wheat planting range, analyze the suitability level of the actual wheat planting area, and complete the area calculation for each township.

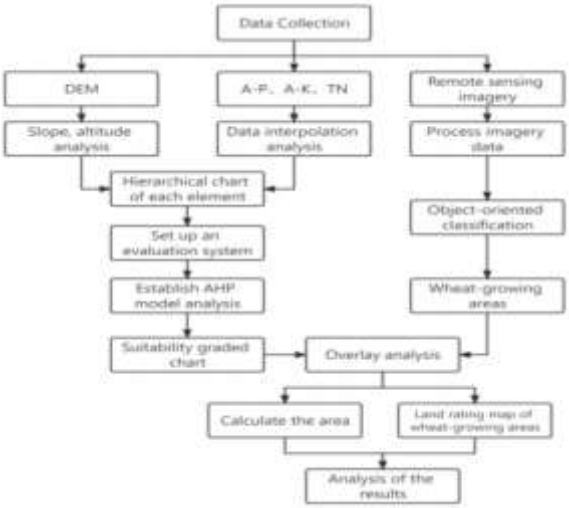

Figure 2 The schema flowchart of this study

3.1. *Calculation of AHP Evaluation Weight Indicators*

Different factors have varying degrees of impact on wheat cultivation, so corresponding weight values need to be applied to different factors according to the actual situation to obtain land suitability grading that conforms to the actual situation. This study uses the Analytic Hierarchy Process (AHP) as the theoretical basis for weight calculation.

AHP is a research method that combines qualitative and quantitative methods to solve complex multi-objective problems, based on which decision weights are calculated. Mainly, using a combination of quantitative and qualitative analysis to determine the relative importance of each measurement objective and provide reasonable weights for each criterion. The main steps of the operation are:

1. Construct a hierarchical structure model.
2. Experts evaluate and score different influencing factors to construct a judgment matrix between the two elements:

$$a_{ij} = \frac{1}{a_{ij}} \quad (1)$$

In formula (1), a_{ij} is the comparison result of the relative importance between factors i and j.

3. Calculate the weights of different factors and verify consistency:

$$CI = \frac{\lambda_{max} - n}{n-1} \quad (2)$$

$$CR = \frac{CI}{RI} \quad (3)$$

Among them formula (2), CI is a deviation consistency indicator; λmax is the maximum eigenvalue of the matrix; n is the order of the matrix. In formula (3), RI is a random consistency indicator; CR is the consistency test value. By calculating each indicator through AHP, if CR<0.1 is obtained, it proves compliance with the consistency test.

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This study evaluated the seven selected factors by experts and relied on the AHP to construct the hierarchical analysis structure and judgment matrix of the factors. Consistency testing was conducted through software, and the combined weight values between each factor were obtained after completion of the testing (Table 1).

Table 1 Evaluation Factor Combination Weights

Factor	Soil nutrients	Site conditions	Physical and chemical properties
TN	0.0775		
A-P	0.1549		
A-K	0.1549		
Slope		0.3321	
Elevation		0.1107	
PH			0.1132
SOM			0.0566
Total	0.3873	0.4428	0.1698

The calculation formula for the multifactor weighted sum model is as follows:

$$P = \sum_{i=1}^{n} W_i X_i \quad (4)$$

In the formula (4), P represents the suitability evaluation index for cultivated land planting, W_i represents the weight of the i^{th} evaluation index obtained by AHP, X_i represents the evaluation index of the i^{th} evaluation index level, and n represents the number of evaluation indicators.

The different indicator grading data and weight levels of each factor obtained from Table 1 are used for overlay analysis to obtain comprehensive evaluation data. According to the actual situation, the data is further divided into different levels of wheat suitability for planting. Mainly divided into four categories: highly suitable, suitable, barely suitable, and unsuitable. The division basis is shown in Table 2.

Table2 Classification of Suitability Levels for Wheat

	Unsuitable	Barely suitable	Suitable	Height suitable
value	＜2.6	2.3~2.6	2~2.3	＜2

3.2. RS Monitoring of Wheat Planting Area

This study used LANDSAT-8 images from April 2021. The data were preprocessed, radiometric calibration and atmospheric correction were performed, and then the images were concatenated and cropped to obtain an image of the study area.

The classification method adopts OOC. It groups the pixels in the image into objects with similar features and then classifies these objects. The principle mainly includes the following aspects:

1. Object Definition: Grouping pixels into objects with certain shape, size, texture, color, and other characteristics that can be described by a set of attributes
2. Feature extraction: It is necessary to extract the features of objects from RS images, including shape, size, texture, color, etc., and then obtain them through RS data processing methods.
3. Object segmentation: Segmenting pixels in an image into different objects; commonly used methods include region segmentation, edge segmentation, etc.
4. Object classification: Classify the segmented objects using supervised or unsupervised classification methods.

Overall, the OOC methods mainly deal with image blocks, which not only contain spectral information but also features such as shape, size, and texture, which can improve the efficiency of classification. Pixel-based image classification can only utilize the spectral information of pixels, which is easily limited by the impact of "same spectral heterogeneity" on classification performance.

OOC is one of the classification methods based on machine learning. This study utilizes supervised classification in this classification method, which selects training sample features for classification operations. It used to distinguish the spectral characteristics of wheat and other major crops in the study area in order to determine the planting area of winter wheat. When selecting training samples, multiple feature points are collected for calculation, and the characteristic value range of winter wheat is found in the NDVI image, which is then used to calculate the spatial distribution data of the wheat planting area in the region. Finally, using the land use dataset generated by the ESRI impact observation station, the cultivated land range in Zhenping County was extracted, and the actual cultivated land range was compared with the wheat planting area in 2021.

3.3. *Suitability Level Calculation for Overlay Analysis*

Overlay analysis is one of the important functions of GIS. Overlay operations can merge, statistically analyze, and perform fusion calculations on various layers, achieving the fusion of all attributes of the participating elements. After overlaying and analyzing the obtained farmland suitability classification map and the actual planting classification image of wheat in 2021, the land suitability level within the wheat planting range in 2021 can be obtained.

In addition, the area calculation method uses ArcGIS attribute's area calculation tool to add information to the feature's attribute fields (representing the spatial or geometric characteristics and positions of each feature), such as length or area, as well as x, y, z coordinates and m values. The area will be calculated in units of the input feature coordinate system. After calculating the area using tools, statistical analysis was conducted to obtain the suitability statistics of wheat planting areas in various townships in Zhenping County in 2021,

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which will provide data support for subsequent analysis (Li et al, 2009).

4. ANALYSIS AND RESULTS

4.1. *Statistics of Suitability for Wheat Planting*

Based on the aforementioned research methods and theoretical support, a grading chart of seven evaluation factors (Figure 3) was created, which clearly shows the distribution pattern of the seven indicator levels. The southern slope of Zhenping County is relatively gentle, and the plain area is vast. Only by analyzing the site conditions can it be determined that most of the southern areas are suitable for wheat cultivation. Combining other soil physical and chemical properties with soil nutrient factors, the weights obtained by the AHP method were weighted and overlaid to obtain the suitability grading map for wheat planting in Zhenping County (Figure 4).

According to the above study and analysis, Zhenping County has a large amount of highly suitable farmland for wheat cultivation. Most of the land has good site conditions, as shown in Figure 4. Most of them are in highly suitable and suitable conditions, while only a few are in barely suitable and unsuitable areas. The main features include flat and large areas of cultivation land that are suitable for large-scale grain crop production, while the slope is also relatively gentle. Excellent land is widely distributed, without being cut off or far apart from each other, with a relatively concentrated distribution. At the same time, the physical and chemical properties of the soil are superior, and the pH value of most areas in the county is within the first and second levels. The organic matter content is relatively low, but the overall distribution difference is not significant and has not had much impact on the research results.

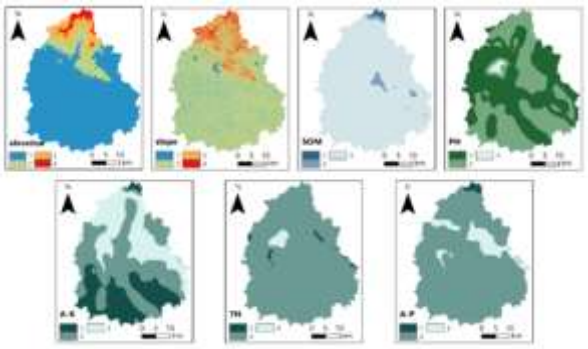

Figure 3 Grading maps of various evaluation factors

(Note: Elevation-altitude factor distribution, slope-slope factor distribution, SOM-organic prime factor distribution, PH-PH factor distribution, A-K-available potassium factor distribution, TN-total nitrogen factor distribution, A-P-available phosphorus factor distribution)

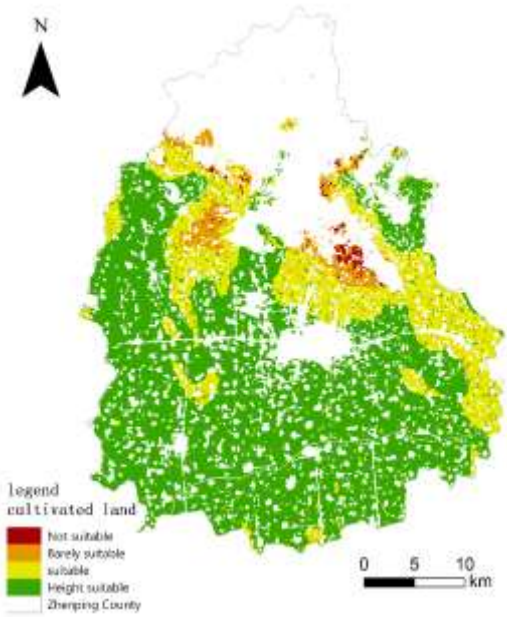

Figure4 Suitability Grading of Wheat-Cultivated Land in Zhenping County

Through the grading in Figure 3, it can be seen that the overall SOM value in Zhenping is relatively low, which does not exclude the fact that the local agricultural production consumes the organic matter content of the soil in the region. Finally, the local soil is relatively rich in nutrients, and there has been no situation where a certain value is too low, resulting in insufficient nutrients. It produces unsuitable and barely suitable areas, mainly influenced by site conditions, resulting in lower scores.

Through calculation and analysis, the study area belongs to highly suitable and suitable areas for wheat cultivation, with approximately 65980.47 hm² and 20265.64 hm², respectively. The proportions are 72.75% and 22.34%. The sum of the two accounts for almost 95% of the total arable land area in Zhenping, indicating that most of the local cultivation land is suitable for planting wheat crops. The area that is barely suitable for wheat cultivation is approximately 3670.62 hm², about 4.04% of the total area. Unsuitable planting area is approximately 774.88hm², about 0.85% of the total area. Overall, most of the arable land in Zhenping is suitable for wheat cultivation, and the suitable planting areas are mostly concentrated in the central, southern, and western regions (Table 3).

Table 3 Calculation of Land Suitability Level Area in Zhenpin g

Type	Unsuitable	Barely suitable	Suitable	Height suitable	Total
Area/hm²	774.88	3670.62	20265.64	65980.47	90691.61
Percentage/%	0.85	4.05	22.35	72.75	100.00

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4.2. Wheat Planting Areas in Zhenping

Extract and map the wheat planting area and distribution data in Zhenping through the classification and calculation of RS images (Figure 5). Based on image analysis, most of the cultivation land was planted with wheat during this season. The total planting area is 90691.61 hm² accounting for 53.82% of the cultivation land area (Table 4).

The classification image shows (Figure 5) that most of the cultivation land in the north is not planted with wheat, and these areas are mostly mountainous areas with higher elevations and larger slopes. The area to the east also has a relatively high altitude, so the wheat planting area is relatively small. The extraction range distribution of wheat cultivation in the western region is sparse, which is relatively loose compared to the actual cultivated land area. But for areas such as towns, roads, mountains, and other areas with significant spectral differences from wheat vegetation, the discrimination is better. Most of the blank areas in the middle are the county seat of Zhenping, while the remaining blank areas and strip blank areas are villages and roads. Analyze the wheat planting area obtained from supervised classification, with an area of approximately, 49000 hm² accounting for 53.7% of the total cultivation and area.

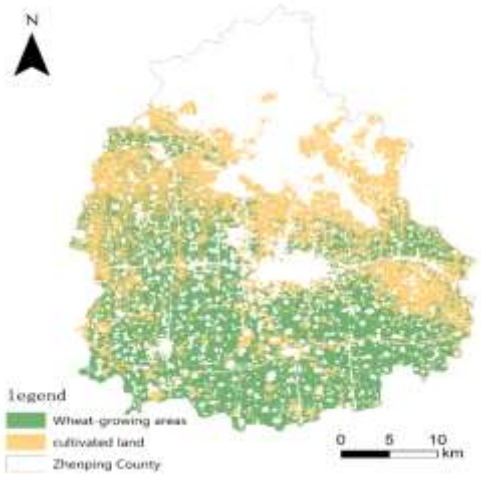

Figure 5 Winter Wheat Planting and Cultivated Land Range in Zhenping in 2021

Table 4 Cultivated Land Area and Wheat Planting Area in Zhenping

	Wheat-growing areas/hm²	**Cultivated land/hm²**	**Proportion of wheat area/%**
Area	**48808.12**	**90691.61**	**53.82**

4.3. Spatial Analysis of Wheat Planting in Suitable Land

By combining the boundaries of towns and districts under the jurisdiction of Zhenping, the actual spatial distribution of winter wheat planting in each township of Zhenping and the suitability grading map of the planting area were obtained (Figure 6). Analysis shows that most of the wheat planting areas are "highly suitable" planting areas, with a total area of approximately 41355.87 hm², about 85% of the wheat planting area is occupied (Table 5).

The planting area is concentrated in Anziying Town, Jiasong Town, Pengying Town, Houji Town, Chaopi Town, and Mazhuang Township. This township is mostly located in the southern and western regions of Zhenping County, with flat terrain, low elevation, and excellent wheat cultivation conditions. Meanwhile, the distribution of villages in this area is also relatively dense, making it the main population-gathering area. The planting conditions in this area are good, and it is speculated that the wheat yield is also relatively high. It is suggested that soil protection be strengthened for this part of the land, and reasonable cultivation should be carried out at the same time to prevent excessive consumption of soil fertility. We must ensure that the cultivated land area does not decrease and strictly approve the expansion of construction land.

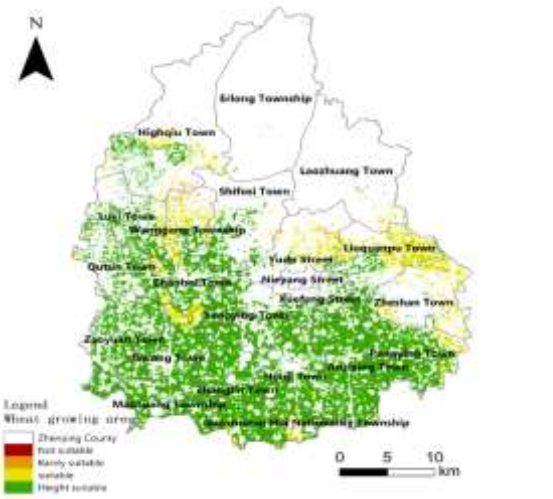

Figure 6: Suitability Zones of Wheat Planting Areas in Zhenping

Table 5 Calculation of Land Suitability Area in Wheat Planting Areas in 2021

Type	Unsuitable	Barely suitable	Suitable	Height suitable	Total
Area/hm²	0.06	3.54	70.93	413.56	488.08
Percentage/%	0.01	0.72	14.53	84.73	100.00

According to Table 5, a total of approximately 70.93 hm^2 (about14.53%) of wheat is planted in "suitable" planting areas, making it the second-largest wheat planting area in Zhenping County. Mainly concentrated in Gaoqiu Town, Liuquanpu Town, Wanggang Township, Yudu Street, Zheshan Town, and other places (Figure 6). This part of the land is affected by soil nutrients, as well as some elevations and slopes. For example, the northern areas of Wanggang Township and Jiasong Town are affected by insufficient soil nutrients, resulting in lower scores. However, Yudu Street, Zheshan Town, and Liuquanpu Town, etc. are affected by the

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terrain, and the large undulations make the ability to maintain soil and water weaker, while also affecting the efficiency of cultivation. In areas where soil conditions are affected by nutrients, it is necessary to appropriately utilize chemical fertilizers to assist in cultivation, strengthen soil regulation, and increase nutrient content; Areas affected by terrain can be transformed according to actual conditions to strengthen soil and water conservation work.

In addition, it can be seen that observing Figures 6 and Table 6, the wheat planting areas in Zhenping have very small planting areas, such as "barely suitable" and "unsuitable". The area of these two types of areas is approximately 3.6 hm^2, accounting for 0.73% of the total wheat planting area. These two regions are also less distributed in the townships under Zhenping. They located in the southern part of Gaoqiu Town, the northern part of Wanggang Township, and the northern part of Yudu Street. These areas are difficult to cultivate due to the influence of terrain, and the cost and difficulty of improvement are high. Considering the actual situation, this area is small and has little impact on the overall wheat yield. It can be ruled out to plant wheat in these areas, switch to economic forests, cultivate or restore the environment for cash crops, and focus on ecological protection.

Table 6: Statistical of the Suitability of Wheat Planting Areas in Various Town

Town	Height suitable		Suitable		Barely suitable		Unsuitable	
	Area/hm²	Percentage	Area/hm²	Percentage	Area/hm²	Percentage	Area/hm²	Percentage
Anziying	4641.65	9.510%	128.65	0.264%	3.54	0.007%		
Chaobei	2073.80	4.249%	333.23	0.683%	2.78	0.006%		
Erlong	14.87	0.030%	3.28	0.007%	0.60	0.001%	0.52	0.001%
Highqiu	1112.88	2.280%	531.70	1.089%	90.08	0.185%	2.53	0.005%
Guozhuang	856.56	1.755%	163.74	0.335%	32.35	0.066%		
Houji	3651.21	7.481%	112.59	0.231%	3.23	0.007%		
Jiasong	3239.78	6.638%	326.06	0.668%	4.26	0.009%		
Laozhuang	50.31	0.103%	144.92	0.297%	6.85	0.014%	0.19	0.000%
Liuquanpu	932.74	1.911%	1541.72	3.159%	9.95	0.020%	1.38	0.003%
Luyi	1453.28	2.978%	211.01	0.432%	1.42	0.003%		
Mazhuang	2236.79	4.583%	31.88	0.065%				
Nieyang	0.49	0.001%	0.18	0.000%				
Pengying	4089.18	8.378%	445.78	0.913%	3.54	0.007%		
Qutun	1806.64	3.702%	80.18	0.164%				
Shifosi	1171.06	2.399%	196.89	0.403%	8.41	0.017%	0.36	0.001%
Wanggang	575.91	1.180%	775.00	1.588%	97.45	0.200%		
Xuefeng	1063.61	2.179%	12.50	0.026%				
Yangying	2676.75	5.484%	148.77	0.305%	0.91	0.002%		
Yudu	304.43	0.624%	644.71	1.321%	72.57	0.149%	1.11	0.002%
Zaoyuan	3257.11	6.673%	15.59	0.032%				
Zhanglin	5733.86	11.748%	210.81	0.432%	3.54	0.007%		
Zheshan	324.39	0.665%	1019.12	2.088%	11.07	0.023%		
Total	41267.31	84.55%	7078.32	14.502%	352.53	0.722%	6.09	0.012%

5. CONCLUSION

This study used the AHP method to construct evaluation indicators and obtain the suitability rating of cultivated land in Zhenping. The suitability level of cultivated land can be divided into four categories: highly suitable, suitable, barely suitable, and unsuitable. Among them, the highly suitable planting area has the largest area and the widest distribution, accounting for approximately 72.75% of the total area. The

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suitable planting area takes second place, accounting for 22.35% of the total arable land area. Those are distributed in the central, southern, and western regions of Zhenping County.

Then, the RS satellite data is used to extract the wheat planting range using OOC methods, and the wheat planting area for 2021 is obtained. Finally, by overlaying the planting area and suitability rating analysis, the suitability of the wheat planting area was obtained. The data management tool of ArcGIS was used to identify specific areas of different suitability zones in each township. The final analysis shows that in 2021, the winter wheat planting area in Zhenping accounted for about 54% of the total arable land area, and about 98% of the locally planted winter wheat was planted in highly suitable and suitable planting areas, mainly distributed in the central and southern parts of Zhenping County, as well as in townships such as Anziying, Chaopi, Houji, Jiasong, Pengying, and Zhanglin.

The study has shown that the selection of wheat planting sites in the local area in 2021 is in line with the principle of farmland suitability, and the overall planting areas are within highly suitable and suitable areas. For other farmland without wheat cultivation, the local area can expand the wheat planting area in highly suitable planting areas based on actual conditions. This result can provide a critical reference for the planting area of crops in Zhenping, optimize the planting layout of crops, and improve rationality.

This study mainly selected seven factors as the basis for local land suitability analysis. In the follow-up research, more advanced technologies and research methods will be used to improve the progressiveness and scientific research, establish more realistic evaluation indicators, and help the scientific and information development of agricultural.

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