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SOIL NUTRIENT CONTENT ANALYSIS OF NEWLY-INCREASED FARMLAND IN THE PROCESS OF LAND CONSOLIDATION IN SHAANXI PROVINCE, CHINA

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Abstract

The aim of this study is to analyze the characteristics of soil nutrient content of newly increased cultivated land in land consolidation, and identify the main factors affecting the productivity of newly increased cultivated land. The soil samples of 101 newly added cultivated land in northern, central and southern Shaanxi were collected, and their pH value, organic matter, total nitrogen, available phosphorus and available potassium contents were measured to analyze the soil nutrient status. The results indicated that the contents of soil organic matter, total nitrogen, available phosphorus and available potassium in the newly increased cultivated land were 0.21~23.63 g/kg, 0.20~8.27 g/kg, 2.34~34.16 mg/kg and 51~220 mg/kg, respectively. Compared with the nutrient grading standard of the second national soil survey, the content of soil nutrients in the newly increased cultivated land was relatively low, basically at the level of four to six. It was also revealed that Tte soil nutrient content of newly increased cultivated land in Shaanxi Province is greatly affected by the original land use types in northern Shaanxi and Guanzhong, and the soil nutrient difference in southern Shaanxi is mainly caused by the random changes among plots in the same region; The variance test showed that there were significant differences in soil pH organic matter and available potassium at 0.05 level, but no significant differences in soil total nitrogen and available phosphorus at 0.05 level. (3) It can be seen from the correlation analysis that among the nutrient indicators of the newly increased farmland in Shaanxi, pH organic matter has a significant negative correlation, and organic matter available potassium and available phosphorus available potassium have a very significant correlation. The correlation between soil nutrients in the newly increased farmland is weak, and the coordination between nutrients is poor. The low content of organic matter in soil is the main reason for low fertility. In the later stage of utilization, it is necessary to promote straw returning technology through the reasonable application of organic inorganic fertilizer and the application of soil testing formula fertilization technology, so as to finally realize the stable and high yield of newly added farmland.

Introduction

China has more people and less land, and the contradiction between people and land is prominent. Food security is a major challenge facing China. In order to ensure the grain production capacity, in recent years, the state has vigorously implemented the policy of "balance between land occupation and land compensation", which means that the land shall be supplemented first and then occupied. Therefore, land consolidation has become an effective measure to increase the number of cultivated land and improve the productivity of cultivated land (Yang *et al*. 2008, Ma *et al*. 2010). Practice has proved that in the vast rural areas, land consolidation methods such as reclamation of abandoned homestead and upgrading of low standard land use can increase the area of effective cultivated land, improve the degree of intensive land use, and play a very important role in promoting the development of rural economy and urban-rural integration.

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However, in the actual process of land consolidation, there are advantages and disadvantages, and paddy fields are used to supplement dry land, resulting in that the productivity of new cultivated land cannot reach the previous level. At present, after the completion of land consolidation, the "five supplies and one leveling" can be basically achieved (Long and Li 2006), and the soil nutrient status has become a key factor affecting agricultural production in the later period. Therefore, it is of great guiding significance to find out the soil nutrient status of fresh cultivated land for better playing the effect of land consolidation and evaluating the quality of new cultivated land and ecological environment (Zhao *et al*. 2015). Previously, there have been a lot of studies on soil fertility of existing basic farmland (Hou *et al*. 2007), but there are few studies on soil nutrient status of new cultivated land after land consolidation. Therefore, it is of great significance to study the soil fertility of the newly increased cultivated land after land consolidation and identify the short board of soil nutrients of the newly increased cultivated land in the region for improving the nutrient level of the newly increased cultivated land in the region and the classification and grading of agricultural land after the implementation of the project. The results can provide scientific basis for land management (Shi *et al*. 2015, Li *et al*. 2015).

In this study, typical land consolidation projects in 20 counties in Shaanxi Province in 2015 were selected to investigate the soil nutrients of the farmland transformed from non-agricultural land such as the original sandy wasteland, saline alkali land, waste grassland and bare rock gravel land. Based on the nutrient grading standard of the second national soil survey, the soil nutrient characteristics of the newly increased farmland were understood, and the soil nutrient conditions that restricted the productivity of the newly increased farmland were discussed, Put forward targeted measures for soil fertility and improvement of new cultivated land, so that the new cultivated land can truly become a reliable guarantee for farmers to increase production and income.

Materials and Methods

Shaanxi Province (31°42’-39°35’N, 105°29’-111°15’E) is located in the middle reaches of the Yellow River in China. With a large latitude span, the terrain is high from north to south and low in the middle, including mountains, plains, plateaus, basins and canyons. It is 870 km long from north to south, 200~500 km wide from east to west, and covers an area of 205800 km^2. It governs 10 cities and 1 district, including Xi'an City, Xianyang City, Baoji City, Weinan City, Yangling District, etc. From the north to the south, it is divided into three geomorphic regions: the Northern Shaanxi Plateau, the Guanzhong Plain, and the Qinling Bashan Mountains, which correspond to three regions, namely, the Southern Shaanxi and the Central Shaanxi and the Northern Shaanxi, respectively, accounting for 45, 19 and 36% of the land area of the province. Due to the obvious influence of monsoon climate and continental climate, from south to north, it has the characteristics of northern subtropical humid climate, warm temperate semi humid climate and warm temperate and temperate semi-arid climate (Zhao *et al*. 2013). The average annual precipitation is 576.9 mm, the average annual temperature is 13°C, and the frost free period is about 218 days. In 2016, the total population of the province was 38.12 million, the annual GDP was 1916.539 billion yuan, the per capita GDP was 50395 yuan, the annual grain sown area was 3.0687 million hm2, and the total grain output was 12.283 million tons.

The newly added cultivated land reclamation project in typical areas of Shaanxi Province was selected, involving 101 sample sites in 20 counties along the Great Wall, the Loess Plateau, Guanzhong Plain and Qinling Bashan Mountains (Fig. 1). The original land use types include sandy wasteland, saline alkali land, gully land, grassland and bare rock gravel land (Table 1). On each type of land, according to the method of plum blossom sampling to collect soil samples, take soil samples of 0~30 cm soil layer on the top of the soil, about 500 g for each soil sample, bag and take it back to the laboratory for indoor analysis.

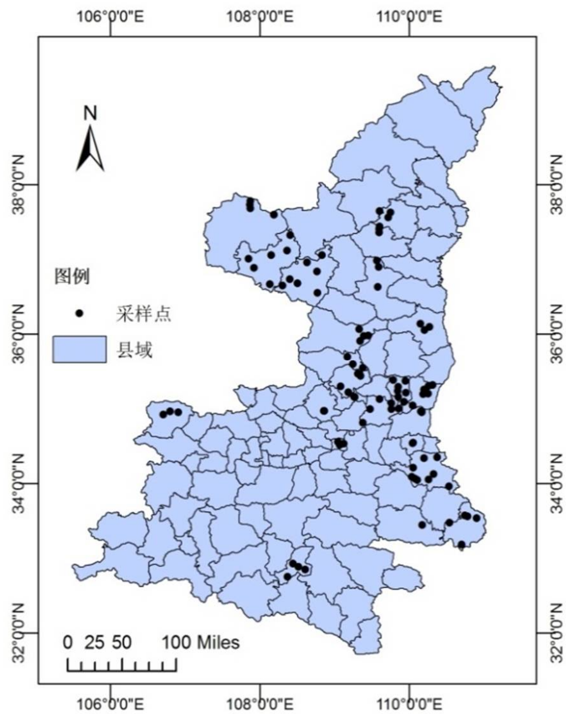

Fig. 1. Distribution map of sampling sites.

Table 1. The former land-use patterns in newly-increased farmland.

Sampling points (number of samples)	Land category	Sampling points (number of samples)	Land category
Dingbian County (6)	Saline and alkaline land, grassland	Chenghceng County (8)	Grassland
Zichang County (6)	Gully land	Dali County (5)	Saline and alkaline land, tidal flat land
Wuqi County (6)	Slope land	Heyang County (5)	Grassland, tidal flat land
Baota District (3)	Grassland	Pucheng County (6)	Saline and alkaline land, grassland
Zhidan County (7)	Grassland	Huayin County (4)	Bare rock gravel, grassland
Yichuan County (3)	Grassland	Gaoling District (3)	Abandoned brick factory
Fuxian County (4)	Grassland	Longxian County (3)	Grassland
Huangling County (3)	Grassland	Luonan County (8)	Grassland
Yijun County (5)	Gully land	Shangnan County (6)	Tidal flat land
Yintai District (3)	Grassland	Hanyin County (4)	Slope land
Yaozhou District (3)	Rural wasteland		

Soil pH was measured by glass electrode method. Organic matter was determined by potassium dichromate oxidation and external heating method. Total nitrogen was determined by semi-micro Kjeldahl method. Available phosphorus was determined by sodium bicarbonate extraction - molybdenum-antimony resistance colorimetric method. The available potassium was determined by neutral ammonium acetate extraction and flame spectrophotometry. The same soil sample was measured three times in parallel with the same index, and its average value was obtained.

SPSS 19.0 was used for data entry, statistics and analysis.

Results and Discussion

Fig. 2 for the spatial pattern of soil pH of newly increased cultivated land. As can be seen from Fig. 1, soil pH of newly cultivated land in Shaanxi Province ranges from 7.14 to 9.19, with an average value of 8.38. The coefficient of variation ranged from 0.33 to 23.57%, with an average value of 2.69%. The new cultivated land showed a weak alkalinity on the whole, and the soil pH variation was extremely mild, indicating that pH content was relatively stable in the soil samples of the new cultivated land. From the regional analysis, the pH of newly added farmland in northern Shaanxi is higher than that in Guanzhong and southern Shaanxi. The average pH of newly added farmland in Dingbian County, Wuqi County, Zhidan County, Yichuan County and Huangling County in Yulin City is more than 8.5, showing alkalinity. The pH of soil in Guanzhong and southern Shaanxi was neutral - weakly alkaline. The soil type, slope aspect and elevation are significantly related to the pH of the topsoil. The smaller the slope is, the higher the elevation is, and the greater the pH is. There are differences in the pH of different types of soil. It is recommended to prevent and control soil salinization in northern Shaanxi and Guanzhong, and soil acidification in southern Shaanxi, so as to promote sustainable agricultural development and ensure regional food security (Wang *et al*. 2021).

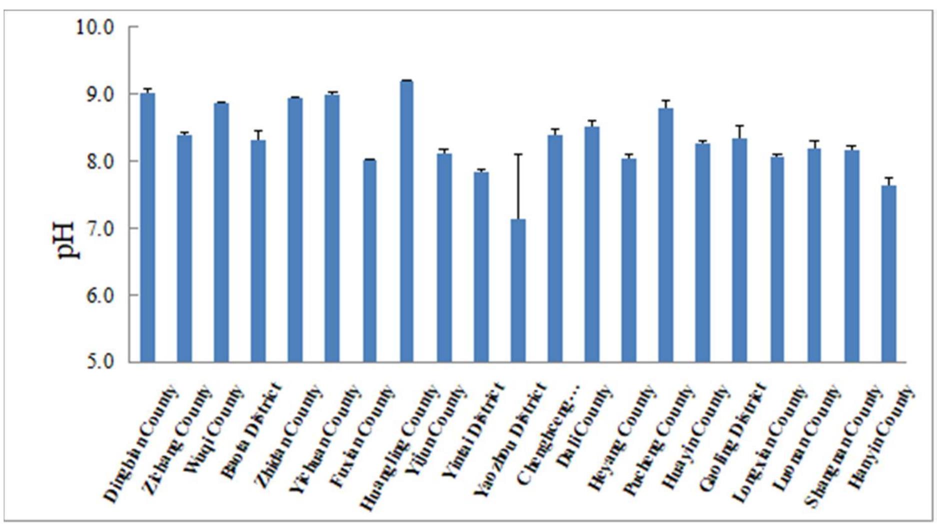

Figure 2. The pH of newly-increased farmland.

After land consolidation in different areas of Shaanxi Province, the soil nutrient content of newly added cultivated land is shown in Tables 2-3.

Table 2. Statistical characteristics of soil nutrient content in newly-increased farmland in Shaanxi province.

Sampling points	Organic matter (g/kg)		Total nitrogen (g/kg)		Available phosphorus (mg/kg)		Available potassium (mg/kg)	
	Av. value	Coefficient of variation (%)	Av. value	Coefficient of variation (%)	Av. value	Coefficient of variation (%)	Av. value	Coefficient of variation (%)
Dingbian County	2.13	9.01	0.70	23.11	2.34	14.00	60	12.87
Zichang County	5.12	16.38	0.41	16.64	28.36	31.08	81	22.32
Wuqi County	2.98	52.65	0.62	114.97	8.44	29.04	70	8.33
Baota District	0.76	60.43	2.76	31.51	3.33	38.75	79	20.59
Zhidan County	0.21	23.34	0.98	86.13	5.00	83.30	64	15.37
Yichuan County	4.66	11.83	3.25	38.46	3.39	11.14	76	26.74
Fuxian County	3.88	14.90	1.25	30.73	9.18	13.98	58	10.05
Huangling County	7.87	23.57	0.85	16.47	4.80	24.17	105	16.83
Yijun County	5.33	30.06	1.08	18.77	5.53	14.76	89	22.89
Yintai District	4.67	10.09	8.27	20.80	3.87	27.54	126	16.23
Yaozhou District	13.10	19.13	0.91	31.28	10.83	54.78	143	26.38
Chengcheng County	6.57	30.49	1.03	20.91	3.60	25.48	51	27.74
Dali County	4.74	29.97	1.15	47.53	23.49	12.22	220	13.82
Heyang County	8.25	26.65	2.57	33.55	6.59	51.84	96	16.85
Pucheng County	23.6	7.04	0.20	56.72	11.25	22.75	155	25.08
Huayin County	5.72	14.91	2.33	109.67	25.87	26.34	242	34.72
Gaoling District	6.63	32.36	0.23	59.13	34.16	15.40	94	10.15
Longxian County	10.70	58.55	1.72	12.89	6.62	22.79	131	15.83
Luonan County	7.99	51.41	0.51	51.14	13.54	65.27	117	21.34
Shangnan County	9.53	80.22	1.64	24.86	17.87	51.74	70	15.54
Hanyin County	12.50	26.46	0.90	33.22	12.58	58.99	89	9.91
Average value	7.00	29.97	1.59	41.83	11.46	33.11	106	18.55

The soil organic matter content of the newly added cultivated land was 0.21-23.63 g/kg, with an average value of 7.00 g/kg, and the coefficient of variation was 7.04% to 80.22%, with an average value of 29.97%, which belonged to the medium variation. According to the nutrient classification standard of the second national soil survey, the content of soil organic matter in most of the newly increased cultivated land is at the level of grade 5 and 6, and the content of organic matter is generally low. Liu have shown that the content of soil organic matter in newly cultivated land is relatively low. The organic fertilizer combined with chemical fertilizer can effectively increase the content of soil organic matter in newly cultivated land, which can be 36.1% higher than that of ordinary fertilization. Optimizing fertilization is an effective measure to improve the stability of soil structure, fertilizer conservation characteristics and land productivity of newly renovated farmland.(Liu *et al*. 2021). From the regional analysis, the content of soil organic matter in newly added farmland in Guanzhong was higher than that in northern and southern Shaanxi.

Table 3. The grades of soil nutrient of newly-increased farmland in Shaanxi province.

Sampling points	Organic matter	Total nitrogen	Available phosphorus	Available potassium
Dingbian County	VI	V	VI	IV
Zichang County	VI	VI	II	IV
Wuqi County	VI	V	IV	IV
Baota District	VI	I	V	IV
Zhidan County	VI	IV	V	IV
Yichuan County	VI	I	V	IV
Fuxian County	VI	III	IV	IV
Huangling County	V	IV	V	III
Yijun County	VI	III	IV	IV
Yintai District	VI	I	V	III
Yaozhou District	V	IV	III	III
Chenghceng County	V	III	V	IV
Dali County	VI	III	II	I
Heyang County	V	I	IV	IV
Pucheng County	V	VI	III	II
Huayin County	VI	I	II	I
Gaoling District	V	VI	II	IV
Longxian County	V	I	IV	III
Luonan County	V	V	III	III
Shangnan County	V	I	III	IV
Hanyin County	IV	IV	III	IV

The nutrient content grading standard refers to the nutrient grading standard of the second national soil survey.

The soil total nitrogen content of the newly added cultivated land was 0.20 ~ 8.27 g/kg, with an average value of 1.59 g/kg, and the coefficient of variation was 12.89%~114.97%, with an average value of 41.83%, belonging to the medium variation. According to the nutrient classification standard of the second national soil survey, the soil total nitrogen content of newly cultivated land in most areas was at the level of 4 ~ 6, and a few areas such as Yijun County and Yintai District reached the level of 1, but the total nitrogen content was generally low. He showed that the total nitrogen mass ratio of soil also increased year by year with the increase of the implementation years of new cultivated land, and reached the maximum value of 0.92g/kg 3 years after the implementation of the project. Compared with that before the project implementation, the total nitrogen mass ratio increased by 19.11%, 3.70% and 3.57% respectively at each stage of the project completion, with the largest increase after the project implementation. This is mainly due to the fact that after the implementation of the project, nitrogen will be supplemented through measures such as soil fertilization, and there will generally be a certain fallow period after the implementation of the project, so that soil nitrogen can be accumulated to a certain extent(He *et al.* 2022). Analysis shows that the change law of total nitrogen mass ratio is similar to that of organic matter. Regional analysis showed that the total nitrogen content of newly added farmland in Guanzhong was higher than that in northern and southern Shaanxi.

The available P content of newly added cultivated land ranged from 2.34 to 34.16 mg/kg, with an average of 11.46 mg/kg, and the coefficient of variation ranged from 11.14% to 83.30%, with an average of 33.11%, which belonged to the medium variation. According to the nutrient classification standard of the second national soil survey, the soil available P content of newly added cultivated land in most areas is at grade 4 ~ Grade 5 level, while the content of available P in Huayin City, Gaoling District and a few other areas reaches grade 2 level. Generally speaking, the content of available P is still low. Hu studied the soil nutrients of the new cultivated land in Heyang, Shaanxi Province, and found that the available phosphorus content in the soil was low, and the nutrient evaluation grade showed that the soil of the poor grade IV accounted for 83.4% (Hu *et al*. 2022), Song Jiajie showed that straw, fertilization and their interaction had a significant impact on the total phosphorus content in the soil layer of 20~40 cm ($P<0.05$). Compared with the treatment without fertilization, fertilization could significantly increase the total phosphorus content in the soil layer ($P<0.05$)(Song *et al.* 2022). From the regional analysis, the soil available P content of newly added farmland in southern Shaanxi was higher than that in northern Shaanxi and Guanzhong.

The soil available potassium content in the newly cultivated land ranges from 51 to 220 mg/kg, with an average value of 106 mg/kg, and the coefficient of variation ranges from 8.33% to 34.72%, with an average value of 18.55%, which belongs to the medium variation. According to the nutrient classification standard of the second national soil survey, the content of available potassium in soil of newly added cultivated land in most areas is at the third-fourth level. The content of available potassium in Dali County and Huayin city reaches the first level, and in general, the content of available potassium is at the medium level. Zhou researched on the newly added cultivated land of Jingtai County, Gansu Province's balance project of occupation and compensation of cultivated land shows that when the new cultivated land is 3 years old, the damage rate of soil structure is 2.05% lower than that when the new cultivated land is 1 year old, and the soil erosion resistance is significantly improved. The soil available potassium is 13.62% higher than that when the new cultivated land is 1 year old, respectively. The quality of the newly added cultivated land has the greatest impact on the grain production capacity, and the cultivation for 5 years can be 15.69% higher than that before the implementation (Zhou 2020). From the regional analysis, the content of soil available potassium in newly added cultivated land in Guanzhong was higher than that in northern and southern Shaanxi.

Soil fertility directly affects land productivity. In general, the soil nutrient content of new cultivated land in Guanzhong region is higher than that in northern and southern Shaanxi, mainly due to the difference of soil types of new cultivated land in various regions. Soil nutrients are greatly affected by terrain, soil type and human activities. Under different soil types, the nutrient content in lou soil is the highest, while that in black loessial soil is lower. The elevation is the dominant factor that causes the spatial variation of soil nutrients. The differences of agricultural production activities, such as fertilization, planting system and straw returning, also affect the spatial variability of soil nutrients to a large extent (Jia *et al*. 2022). The soil types in northern Shaanxi are mainly aeolian sandy soil and loess soil; The soil type in Guanzhong area is mainly lou soil; The soil type in southern Shaanxi is mainly paddy soil. Aeolian sandy soil and loess soil in northern Shaanxi, mountainous brown soil, mountainous yellow cinnamon soil and calcareous soil in southern Shaanxi have low nutrient content. The soil types with relatively high nutrient content are lou soil in Guanzhong Basin and paddy soil in Hanjiang Valley, and the land yield is relatively high.

In order to eliminate the influence of regional differences on soil nutrients, the variance analysis of soil nutrients between counties and different regions was carried out. It can be seen that the soil nutrient indexes of newly added cultivated land in Shaanxi Province were significantly different at the 0.05 level between counties in northern Shaanxi and Guanzhong, while the soil pH, total nitrogen and available potassium were significantly different at the 0.05 level between counties in southern Shaanxi Province, while the soil organic matter and available phosphorus were not significantly different at the 0.05 level (Table 4); There are significant differences in pH organic matter and available potassium of newly increased cultivated land between northern Shaanxi, Guanzhong and southern Shaanxi at 0.05 level, while there are no significant differences in total nitrogen and available phosphorus of soil at 0.05 level (Table 5). Zhao studied the spatial heterogeneity of soil nutrients in the transitional zone between Maowusu Desert and the Loess Plateau through semi variance analysis. The results showed that total nitrogen and available phosphorus had strong spatial correlation, and structural factors played a leading role in the variation; Available potassium has a medium intensity of spatial correlation, and structural factors and random factors play a leading role in the variationt (Zhao *et al*. 2016). The results showed that the soil nutrient difference of newly cultivated land in northern Shaanxi and Guanzhong was mainly affected by the land type in the original land consolidation area. The difference of soil nutrients in newly added cultivated land in southern Shaanxi was mainly caused by the random variation between plots in the same region.

Table 4. ANOVA of soil nutrients in newly-increased farmland in rural areas of Shaanxi province.

Sampling points	Index	Freedom	Sum of squares	Mean square	$F_{0.05}$	Pr>F
Northern Shaanxi	pH	7	5.101	0.729	60.900	<0.001
	Organic matter	7	183.301	26.186	31.510	<0.001
	Total nitrogen	7	27.698	3.957	9.860	<0.001
	Available phosphorus	7	2873.230	410.461	23.050	<0.001
	Available potassium	7	5903.652	843.379	5.350	0.0005
Guanzhong region	pH	9	6.908	0.768	3.760	0.0023
	Organic matter	9	1663.015	184.779	55.610	<0.001
	Total nitrogen	9	168.149	18.683	21.440	<0.001
	Available phosphorus	9	5233.262	581.474	44.980	<0.001
	Available potassium	9	146396.136	16266.237	13.960	0.0005
Southern Shaanxi	pH	2	0.882	0.441	6.890	0.0075
	Organic matter	2	53.590	26.795	0.910	0.4256
	Total nitrogen	2	4.430	2.215	21.110	<0.001
	Available phosphorus	2	89.147	44.573	0.590	0.5683
	Available potassium	2	7841.361	3920.681	11.290	0.0010

Table 5. ANOVA of soil nutrients in newly-increased farmland in urban areas of Shaanxi province.

Index	Freedom	Sum of squares	Mean square	$F_{0.05}$	Pr>F
pH	2	1.532	0.766	4.530	0.0256
Organic matter	2	142.768	71.384	3.450	0.0553
Total nitrogen	2	2.257	1.129	0.330	0.7243
Available phosphorus	2	155.677	77.839	0.850	0.4456
Available potassium	2	16776.318	8388.159	4.160	0.0338

The mean square comparison shows that the difference of soil nutrients of newly increased cultivated land in southern Shaanxi is mainly affected by the formation environment and the operation of consolidation technology, which is difficult to reflect the difference between the original land use types; However, the soil nutrient content of newly increased cultivated land in northern Shaanxi and Guanzhong regions is greatly affected by regions, forming significant differences. Fertilization methods should be properly adjusted according to land use types in different regions. Gao showed that part of soil nutrients mainly came from the decomposition of original minerals in soil parent materials, and different soil parent materials also determined the development of different soil types. In addition, the chemical reaction of soil water caused by artificial fertilization, crop consumption and irrigation and drainage in the later period will also have a significant impact on soil nutrients. And nutrient loss, which is one of the typical differences between cultivated soil and natural soil (Gao *et al.* 2021).

The content of soil nutrients is related to many factors, and each nutrient has a complex correlation. Organic matter, nitrogen, phosphorus and potassium are both independent and interrelated, which together guarantee the growth and development of crops. Understanding the relationship between various nutrient factors can give a more comprehensive understanding of the soil fertility structure, research on the consumption or accumulation of soil nutrients can reveal the cycle and balance of nutrients in the soil crop system. Long term application of organic and inorganic fertilizers can comprehensively improve the content of soil nitrogen, phosphorus, potassium, organic matter and CEC, and effectively regulate soil pH (Xu *et al.* 2006). See Table 6 for the correlation analysis of soil nutrients in the new cultivated land of land consolidation in Shaanxi Province.

Table 6. Correlation between available nutrients in newly-increased farmland in Shaanxi province.

Index	pH	Organic matter	Total nitrogen	Available phosphorus	Available potassium
pH	1				
Organic matter	-0.20*	1			
Total nitrogen	-0.19	-0.13	1		
Available phosphorus	-0.10	0.11	-0.18	1	
Available potassium	-0.09	0.31**	0.16	0.43**	1

* Indicates significant correlation at 0.05 level; * * Indicates significant correlation at 0.01 level.

According to the test, among the nutrient indicators, pH organic matter has a significant negative correlation, and organic matter available potassium and available phosphorus available potassium have a very significant correlation. The correlation between soil nutrients in the newly added farmland in Shaanxi Province is weak, and the coordination between nutrients is poor. The high and stable yield of farmland requires sufficient and coordinated soil nutrients. Through fertilization and later cultivation, the soil nutrient content has been greatly improved, its spatial difference is weakened, and its homogenization is enhanced. The correlation between soil nutrient contents is weakened and the coordination is reduced, which is mainly due to the dependence on chemical fertilizer. In the later stage, the soil nutrient should be improved through field management and increased application of organic fertilizer (Zhang *et al.* 2022).

The content of organic matter in the soil of new cultivated land in Shaanxi Province is of medium variation, and the difference of organic matter content is obvious among different regions. The organic matter available potassium and available phosphorus available potassium have extremely significant correlation, with the correlation coefficients reaching 0.31 and 0.43 respectively. This is mainly because the new cultivated land is mainly fertilized by organic fertilizer, and the organic matter, N, P and other nutrients in the organic fertilizer are high. Increasing the application of organic fertilizer can improve the content of N, P, K and other nutrients in the soil. There is a significant negative correlation between soil pH and organic matter in the newly increased cultivated land, with a correlation coefficient of -0.20. Although the correlation with total nitrogen, available phosphorus and available potassium does not reach a significant level, there is still a certain negative correlation. Therefore, reducing soil acidity can increase the content of nutrients such as soil alkali hydrolyzable nitrogen and available potassium, and promote crop growth (Yang *et al.* 2009). Soil organic matter is an important source of plant nutrient elements. It plays a good role in improving soil structure, increasing soil microbial activity, enhancing soil enzyme activity, etc. By increasing the application of organic fertilizer, the quality fraction of soil organic matter is increased, so as to improve soil fertility (Xie *et al.* 2001).

Compared with the nutrient classification standard of the second national soil survey, it can be seen that after land consolidation in Shaanxi Province, the soil nutrient content of newly added cultivated land is not high. The soil nutrient content of new cultivated land in northern Shaanxi and Guanzhong was greatly affected by the land type of the original land consolidation area. The southern Shaanxi region is mainly caused by the random variation among the inner blocks in the same region. In Shaanxi Province, the correlation of soil nutrient contents was poor, except for pH- organic matter, organic matter - available potassium and available phosphorus - available potassium, the other nutrient contents showed no obvious correlation. According to existing research results, organic matter in soil nutrients is not only an important source of various nutrient elements in soil, especially N and P, but also conducive to improving soil fertility and buffering capacity, increasing soil nutrient availability, microbial activity and improving soil structure, thus improving the physical and chemical properties of soil (Huang *et al.* 2015). It can also be inferred that the low content of organic matter in newly added cultivated soil in land consolidation projects in Shaanxi Province is the main reason for low fertility, and the level of soil nutrients has become an important factor restricting the land production capacity and influencing the yield difference after land consolidation. Therefore, the following measures can be taken to improve the soil nutrient content of new cultivated land:

(1) As soil organic matter plays an important role in improving soil physical and chemical properties and adjusting soil fertility factors, maintaining soil organic matter balance and gradually increasing soil organic matter content should be taken as the central link of soil fertility in the future. In terms of soil fertility, the combination of organic and inorganic fertilizers should be advocated, which can expand soil total nitrogen content and effective nitrogen pool, and significantly improve soil nitrogen fertility level. At the same time, the reasonable application of organic and inorganic fertilizers is an effective measure to maintain the good basic physical and chemical properties of farmland soil, and a key soil fertility measure to maintain sustainable agricultural development.

(2) In terms of planting mode, it is recommended to plant annual green manure to press green, plant beans and other crops at the initial stage of reclamation, or plant rape and other crops (Ma *et al.* 2012); Through the combination of land cultivation and cultivation, crop rotation is implemented, straw returning measures are promoted, and more nitrogen and potassium fertilizers are applied to ensure the balanced supply of nutrients in the newly increased farmland, so as to achieve sustainable and stable yield and high yield of the developed farmland.

(3) Promote soil testing formula fertilization technology, find out soil fertility through soil testing, carry out accurate application of nitrogen, phosphorus, potassium, medium and trace elements in different growth periods according to crop growth rules, eliminate soil nutrient

barriers, and improve fertilizer utilization efficiency, which can not only achieve the purpose of increasing and stabilizing yield, but also improve plant agronomic properties and improve the quality of agricultural products (Luo *et al*. 2013, Xiang *et al*. 2006).

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