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Study on the Characteristics and Driving Factors of Vegetation Cover in Shiyang River Basin from 1990 to 2015

Jiuhe Shi[1], Haibo Liu[1], Fan Yu[2,*]

[1]School of Environment Engineering, Beijing Jiaotong University, Beijing, China
[2]Beijing University of Civil Enginering and Architecture, Beijing, China
yufan@bucea.edu.cn
**Corresponding author*

Abstract: *The earth is the home of human survival, and vegetation, as an important natural resource on the land surface, has the functions of sand sealing and soil consolidation, water conservation and so on. Change of vegetation can reflect the change of ecological environment. It is also an important role in the energy cycle and water cycle of the earth's surface and atmosphere. By studying the change of vegetation coverage, we can get the information of ecology and water source. Then, we need to take effective measures to improve our ecological environment. It is also of great significance for us to understand the ecological environment. In this paper, the clear images of 1990, 1998, 2015and 2018in June and July are downloaded from Landsat 8 satellite image data. The vegetation index NDVI of each year is calculated by ArcMap software, and the vegetation coverage is calculated by NDVI. The changes of NDVI and vegetation coverage are analysed. The influencing factors of vegetation coverage and the objective control methods are put forward. Based on the change of vegetation coverage from 1990to 2018, it is concluded that the area of vegetation restoration in the upper reaches of Shiyang River Basin is larger than that of degradation, that in the middle reaches of the basin is larger than that of degradation that in the lower reaches of the basin is larger than that of vegetation restoration, and that in Minqin Basin is larger than that of vegetation restoration Product. Generally speaking, the area of vegetation restoration in Shiyang River Basin is slightly larger than that of vegetation degradation. Based on the statistical analysis of the vegetation coverage in the basin, we should focus on the control of the vegetation in the extremely low vegetation coverage area and the medium vegetation coverage area.*

Keywords: *Shiyang River Basin, Vegetation Coverage, Vegetation Index*

1. Introduction

1.1. Background of the Topic

Since modern times, with the development of industrial revolution, the level of science and technology and economy has been improved rapidly, and the quality of people's life has been guaranteed. However, the environmental problems have become more and more serious. Natural resources are endlessly claimed by greedy human beings, but economic growth has destroyed the ecological balance of nature. Various environmental problems emerge in endlessly. Greenhouse gas emissions lead to global warming, acid rain, land desertification and species extinction. While realizing social progress, we should face up to the influence of bad environment and strive to realize the harmonious coexistence of human and nature.

Land is an important part of the earth, is the home of human survival. Vegetation is an important part of the earth's environmental ecosystem. Vegetation can exchange energy and change atmospheric and soil materials. Vegetation plays an important role in changing surface conditions and water cycle in climate change. Maintaining ecological balance can purify soil and atmosphere and reduce surface water loss through the synthesis and decomposition of vegetation [1].

The definition of vegetation coverage (FVC) refers to the proportion or percentage of the vertical projection area of vegetation leaves, stems and branches in the total statistical area. The main function is to measure the change degree of vegetation and reflect the growth status of vegetation. This is an

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important way to understand the environmental carrying capacity. FVC can provide research data on ecology, soil and plants, such as land cover and ecosystem change. It plays an important role in studying the interaction of soil, atmosphere, hydrosphere and biosphere. Therefore, how to reasonably evaluate the interaction between FVC and environment is a subject worthy of further study.

Northwest China is a large arid area, but there are also some inland river basins. Although there are rivers, water resources are still very scarce, leading to more and more serious ecological and environmental problems [2]. A large number of groundwater exploitation and neglect of water resources protection have indirectly led to a serious decline in economic level and a decline in people's income. Shiyang River Basin is located in the arid area of Western China. The ecological environment is fragile, the precipitation is small, the climate is changeable, and the temperature difference between day and night is large. There are many distinctive landforms and vegetation in Shiyang River Basin.

This paper studies the change of vegetation coverage and the influence factors of surrounding environment in Shiyang River Basin. The main location of Shiyang River Basin is in the east of Gansu Hexi corridor. The local climate is dry, the ecological environment is fragile, the solar radiation is strong, the rainfall is small, and the temperature difference is big. In addition, the water system originated from Qilian Mountains, with a large population and developed economy, but the environmental problems are particularly serious. Therefore, the study of the arid area is helpful to understand the change of vegetation coverage and find out the environmental factors. Therefore, this paper takes Shiyang River Basin as the research area, uses MODIS satellite data, Google Earth engine and other tools to analyze the spatial and temporal changes of vegetation coverage, and calculates the vegetation coverage with ArcMap, so as to explore the relationship between FVC and environmental impact factors combined with precipitation, climate and other related factors.

2. A Data Sources and Research Methods

From the landsat8 download system, select the clear images of June and July each year in 1990, 1998, 2015 and 2018 for download.

Normalized vegetation index, red light band reflectivity, NIR near infrared band reflectivity. Suppose a pixel can contain vegetation and soil. The information received through the sensor P, can be defined as the observed vegetation information P1 and soil information P2:

$$P = a \times L_{veg} + (1 - a) \times Soil \quad (1)$$

The formula for estimating vegetation cover can be obtained by changing the formula:

$$a = (P - L_{soil})/(L_{veg} - L_{soil}) \quad (2)$$

3. Characteristics of Vegetation Index NDVI

3.1. Classification and Mapping of NDVI

In order to better and more accurately reflect the change of vegetation index, the vegetation index is divided into several grades according to the vegetation coverage. In addition, different vegetation indexes are represented by several colors in the figure. In this way, the classification map of normalized vegetation index can be obtained. It can be seen from the figure that there are some regional differences in the vegetation index of the basin. For example, the vegetation index of the South Qilian Mountains is generally high, while that of the northern desert area is generally low. In addition to the index, the NDVI normalized vegetation index of the South Qilian Mountains changed significantly [3]. Among them, the fluctuation in the central plain area is larger than that in the northern desert area.

3.2. Spatial Distribution NDVI Vegetation Index

NDVI spatial distribution of vegetation indices in the Shiyang River basin will also be affected by some natural conditions, including some land use, and its regional distribution is analyzed as follows:

(1) The Qilian Mountains in the south of the Shiyang River Basin, The mountains are tall, The cold zone of the Qinghai - Tibet Plateau, Precipitation is more appropriate, Therefore, the climate is relatively humid. The area above 4199 meters above sea level is the mountain glacier area, The area is heavily snowed, Barely any vegetation, Are generally negative in the normalized NDVI vegetation

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index, Little significant change, And, The difference in this region is not obvious. The area between 3599 and 4199 meters above sea level is the alpine desert zone, There are some extremely cold plants, Its external features are particularly rare, Including moss-like fleas, snow lotus, mountain grass eggplant, Rhodiola, These plants are low, Production is also lower than other vegetation, So the vegetation index of these plants is much lower than the average of the plant vegetation index in the basin, And they are less affected by seasonal climate. Between 3199-3599 meters above sea level are subalpine meadows and alpine meadows, the main representative of alpine meadow is miscellaneous grass, low grass type pole grass alpine meadow, also included are some low-wet, alpine swamp meadows [4]. The main vegetation of alpine meadow is Penny's, moss grass, Weiling vegetable grass, because there are more vegetation types in this area, So the vegetation index between them also fluctuates greatly, Therefore, the change of vegetation index is particularly significant. Between 2299 and 3199 meters above sea level, Annual precipitation above 199 mm, Maximum precipitation up to 799 mm, the relative humidity is about 59%, Evaporation 699 mm, the frost-free period is about 100 days. This area is very suitable for the growth of forest and grass, in the southern Qilian Mountains, the vegetation index here is much higher than the average vegetation index in the Shiyang River basin, and the difference between them is not significant, the year changed the most. An area between 1599 and 2299 meters above sea level, the climate here is cold, it is the dividing line between agriculture and forestry. Although the climate is cold, without enough heat, but it's still good for forests, grass, crops, In Hexi area belongs to the important animal husbandry and forestry base. Among them, Grassland and arable land occupy a large area of land, so the vegetation index is higher than the average of the watershed vegetation index; the change was significant during the year.

(2) The central plain area of the Shiyang River Basin, which is between 1499 and 2499 m above sea level and is a temperate arid and semi-desert climate, is hot and dry in summer, especially cold in winter, and is particularly rich in light resources and hot spots in summer. The annual average temperature is 4.9-9. Between the ℃, this area is located in the middle and lower reaches of each river in the Shiyang River Basin, forming a huge alluvial plain for the impact of the alluvial fan of the ancient river. The oasis irrigation area is mainly here, and the Minqin oasis in the south can provide enough light and heat resources for the lower reaches of the Shiyang River, isolate the two deserts around it, and provide important resources for the survival and development of Wuwei Oasis. The northern Changning Basin oasis belongs to the lower reaches of the Xida River. The production of the oasis mainly depends on the exploitation of groundwater here. There are also abundant light and heat resources and strong evaporation. The vegetation types here are mainly grassland and cultivated land. The difference in the region is obvious; the change fluctuates greatly in the year.

(3) Deserts in the northern part of the Shiyang River Basin, which mainly include deserts, Gobi and low hills, with low hills in the area between 1019-1999 meters above sea level and desert areas in the area between 1299-1599 meters above sea level [5]. The desert includes most of the mobile dunes, a few of which are fixed and semi-fixed dunes. The wind-sand features are marked by no vegetation and a vegetation index of 0. The desert and Gobi areas are mainly affected by the underlying surface information, and the influence is relatively large, so the vegetation index value is usually unstable, so it cannot` be used as the real value of vegetation cover. The difference in this area is not significant, and the change fluctuation in the year is small.

4. Analysis of Vegetation Coverage in Shiyang River Basin

The Shiyang River Basin can be divided into upstream, middle and downstream regions, and the Minqin basin, Classification of vegetation cover, the results are shown in the figure. Aggregate the area of vegetation and calculate the proportion of vegetation corresponding to each grade, Make the corresponding area legend. Calculation of vegetation cover for TM images in 1990, 1998, 2015 and 2018, A map of changes in vegetation cover from 1990 to 2018 is available, Based on the analysis of vegetation coverage in Shiyang River Basin, The law of vegetation restoration and degradation in the basin over the past 28 years can be obtained. In the classification of vegetation cover, defining vegetation cover less than 10% as a very low vegetation cover area, the region is characterized by land types similar to deserts, And the grass is scarce, Belong to inferior coverage type. Defining vegetation coverage between 10 and 30 per cent as low vegetation cover, the area is characterized by a similar land type to the intensity erosion zone, including a small number of desertification land, grassland production close to balance, but there's less vegetation here, Belong to poor coverage. Defining vegetation coverage between 30 and 50 per cent as medium vegetation cover, the region is characterized by land similar to low- and middle-yield grasslands, Belong to a more balanced coverage.

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Defining vegetation coverage between 50% and 70% as medium and high vegetation cover, the area is characterized by a similar vegetation to medium and high yield grasslands, it belongs to high vegetation coverage. High vegetation cover areas with vegetation coverage of more than 70 per cent, the region is characterized by a land similarity to high-yielding grasslands, And the woodlands are dense, Rich in soil resources, it belongs to high vegetation coverage(see table 1).

Table 1: Classification of vegetation cover

Classification	Vegetation coverage	Characteristics
Very low vegetation cover	F VC ≤10 per cent	Desertification
Low vegetation coverage	10<F VC ≤30 per cent	Intensity erosion zone
Medium vegetation cover	30<FVC ≤50 per cent	Low grassland yield
Medium and High Vegetation Coverage	50<FVC ≤70 per cent	High low yield of grass
High vegetation coverage	F VC ≥70 per cent	Low yield of grass and dense forest land

5. Spatial Distribution NDVI Vegetation Index

From the landsat8 download system, clear images of good vegetation growth in June and July of 1990, 1998, 2015 and 2018 are selected for download, And according to the calculation as the annual vegetation coverage. According to the classification criteria for vegetation cover, applying a reclassification tool in the arcmap to treat vegetation cover in the Shiyang River Basin, the results are shown below. Then the vegetation area of each grade is summarized, the results are shown below. Then calculate the proportion of vegetation according to the above area, the results are shown below. As shown here, the vegetation area of the high vegetation cover area in the upper reaches of the basin is steadily increasing. The changes of vegetation area in very low vegetation cover area, moderate vegetation cover area and middle and high vegetation cover area are obvious. In 2018, the proportion of vegetation area in medium vegetation cover area decreased, the proportion of vegetation area in low vegetation cover areas is also gradually decreasing. As can be seen in the vegetation cover image, the vegetation cover is less than 0 and more than 1, And in a balanced state. The proportion of vegetation in high vegetation cover areas in the middle reaches of the basin is slowly rising. The vegetation area of low vegetation cover area, moderate vegetation cover area and middle and high vegetation cover area changed significantly. Vegetation in very low vegetation cover areas is changing, And the proportion of the area is slowly rising. The proportion of vegetation area in high vegetation cover areas downstream of the basin is slowly decreasing. The vegetation cover is located in the very low vegetation cover area, the low vegetation cover area and the moderate vegetation cover area, as well as the middle and high vegetation cover area. Globally, the proportion of vegetation area in low vegetation cover area is increasing slowly. The proportion of vegetation area in middle and high vegetation cover area and high vegetation cover area in Minqin Basin is decreasing rapidly. The proportion of vegetation cover area in moderate vegetation cover area changed significantly. Globally, the proportion of vegetation coverage area is slowly decreasing. The proportion of vegetation cover area in low vegetation cover area changed significantly, the rise is more significant. The proportion of vegetation area in very low vegetation cover areas varies slightly, is slowly rising. The proportion of vegetation area in the high vegetation cover area of Shiyang River Basin shows a stable condition. The proportion of vegetation cover in very low vegetation cover area, low vegetation cover area, moderate vegetation cover area and total high vegetation cover area is obviously changed, The proportion of vegetation cover in very low vegetation cover areas, low vegetation cover areas and middle and high vegetation cover areas has increased slightly in general. The proportion of vegetation area in moderate vegetation cover area is generally slightly reduced (see table 2-5).

Table 2: Data in 1990

1990	Very low vegetation cover	Low vegetation cover	Medium vegetation cover	Medium-high vegetation cover	High vegetation cover	Total
Upstream	99.75	631.46	1940.11	2848.52	4853.72	10373.56
Middle	201.47	1827.79	1957.13	1655.44	1369.59	7011.42
Downstream	512.63	7845.52	5846.62	2187.43	3591.46	19983.66

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Table 3: Data in 1998

1998	Very low vegetation cover	Low vegetation cover	Medium vegetation cover	Medium-high vegetation cover	High vegetation cover	Total
Upstream	65.56	267.78	1134.68	2976.47	5988.13	10432.62
Middle	110.36	639.54	2713.56	3707.76	1106.39	8277.61
Downstream	397.44	6413.89	6984.32	3365.33	3535.01	20605.99

Table 4: Data in 2015

2015	Very low vegetation cover	Low vegetation cover	Medium vegetation cover	Medium-high vegetation cover	High vegetation cover	Total
Upstream	57.12	702.78	1594.77	2588.16	5686.33	10629.16
Middle	484.15	2854.96	1802.01	1336.29	1546.47	8023.28
Downstream	2421.44	11292.78	2521.01	2054.69	2505.82	20795.74

Table 5: Data in 2018

2018	Very low vegetation cover	Low vegetation cover	Medium vegetation cover	Medium-high vegetation cover	High vegetation cover	Total
Upstream	60.37	350.73	941.77	2857.32	6312.89	10523.08
Middle	273.67	1578.09	3051.99	1923.25	1603.74	8430.74
Downstream	783.22	9823.56	4923.68	2567.97	2968.12	21066.55

Using the grid calculator Raster Calculator to calculate vegetation coverage data for 1990,1998,2015 and 2018 in arcmap, it can be concluded that the vegetation coverage changes from 1990 to 2018, According to the classification criteria for vegetation cover, calculated vegetation coverage images were recalculated in arcmap software. Then the proportion of vegetation area in the upper, middle, lower and Minqin basins of Shiyang River basin is statistically analyzed. A comparative analysis of the same research area in the Shiyang River Basin in 1990, 1998, 2015 and 2018, if the proportion of vegetation in the basin changes from small to large, the vegetation in this area is in a state of restoration. If the proportion of vegetation in the basin changes from large to small, the vegetation in this area is degraded. The analysis chart shows that the vegetation fluctuation in the upper reaches of Shiyang River basin does not change obviously, Mainly minor recovery, The proportion of vegetation covers approximately 79 per cent of the total upstream area, The rest of the vegetation is slightly degraded [6], the proportion of vegetation covers approximately 9 per cent of the total upstream area, And the vegetation coverage here is significantly degraded, But the rate of degradation is not obvious, About 0.81% and 2.42% respectively. As a result, the protection of vegetation in the upper reaches of the basin over the years is more adequate. The vegetation in the middle reaches of the Shiyang River Basin is mainly slightly degraded, about 75.9% of the midstream area, and the rate of degradation is about 5.83%, and there is some seriously degraded vegetation, the proportion is about 4.19. As a result, the protection of vegetation in the middle reaches of the basin is obviously inadequate. The vegetation in the lower reaches of Shiyang River Basin is mainly stable, but there is some slightly degraded vegetation, both accounted for 68.97 per cent of the total downstream area, and the rate of degradation is about 8.27%, the proportion of severe vegetation degradation is about 8.75. As a result, the vegetation damage in the lower reaches of the basin is obvious. The vegetation cover in Minqin basin mainly includes stable and slight degradation, the proportion of vegetation area is about 72.84% of the total basin area, and the rate of degradation is about 6.27%, the proportion of severe degradation is about 7.57. As a result, the government didn't pay attention to the protection of vegetation in Minqin basin, No strength. Similar to the fluctuation of vegetation in the lower reaches of Shiyang River Basin, the proportion of vegetation area in Shiyang River basin is mainly stable, the proportion accounts for about 48.03% of the total area of the basin [7, 8]. And the rest of the vegetation coverage levels fluctuate more evenly, degraded and severely degraded vegetation exists in the desert margins downstream of the basin, And the upper and middle reaches of the basin, There are also a few areas of recovery and complete recovery at the downstream river network edge, In general, the basin shows a relatively stable trend.

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6. Results

The vegetation coverage of Shiyang River Basin from 1990 to 2018 was analyzed. In the 28 years from 1990 to 2018, the vegetation restoration in the upper and middle reaches of Shiyang River Basin was better. However, the vegetation in the lower reaches of the basin is degraded seriously, and the vegetation in Minqin basin is degraded significantly. According to the analysis of the whole Shiyang River basin, the vegetation restoration in the upper, middle, lower and Minqin basins of the basin has basically maintained a stable trend. By analyzing the monthly vegetation coverage of Shiyang River Basin in 2018, it can be concluded that the fluctuation of vegetation coverage in 2018 is closely related to the season, with significant seasonal changes, which is very similar to the seasonal changes in nature [9].

Drawing on MODIS data processed by some scholars, The change of vegetation coverage in Shiyang River Basin, Yang Kaijun and other scholars used GIS software to extract vegetation index NDVI and EVI, of MODIS products under different conditions It is proved that the vegetation cover in the southern Qilian Mountains, the central plain and the northern desert areas in the Shiyang River Basin has different characteristics, The experiment shows that the vegetation in Shiyang River basin is mainly stable from 2000 to 2007, During this time, The proportion of vegetation degradation in the basin is less than that of restoration. Among them, the influence on vegetation coverage in Shiyang River basin is water resources, the effect of rivers on vegetation cover ranges from 4.4 km to 5.2 km [10]. The This paper is based on the processing of MODIS data, the analysis of pixel dichotomy model, the statistics of data in each year, and the use of ArcGIS software for data processing, According to the normalized vegetation index map, vegetation cover distribution map, The vegetation cover of different grades in Shiyang River basin was analyzed, from 2000 to 2007, the vegetation in Shiyang River Basin was mainly stable.

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