Spatio-temporal Changes and Influencing Factors of Vegetation Coverage in Yulin City During the Past Two Decades since the Implementation of the"Grain for Green" Program

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01

The backgroud of the research

Fractional Vegetation Coverage

significance

- Indicative of climate, hydrology and ecology in the region

Spatial and temporal variation characteristics of vegetation cover are influenced by multiple factors

The change of vegetation cover over time is the result of dynamic changes of dominant factors in the evolution of regional ecological environment

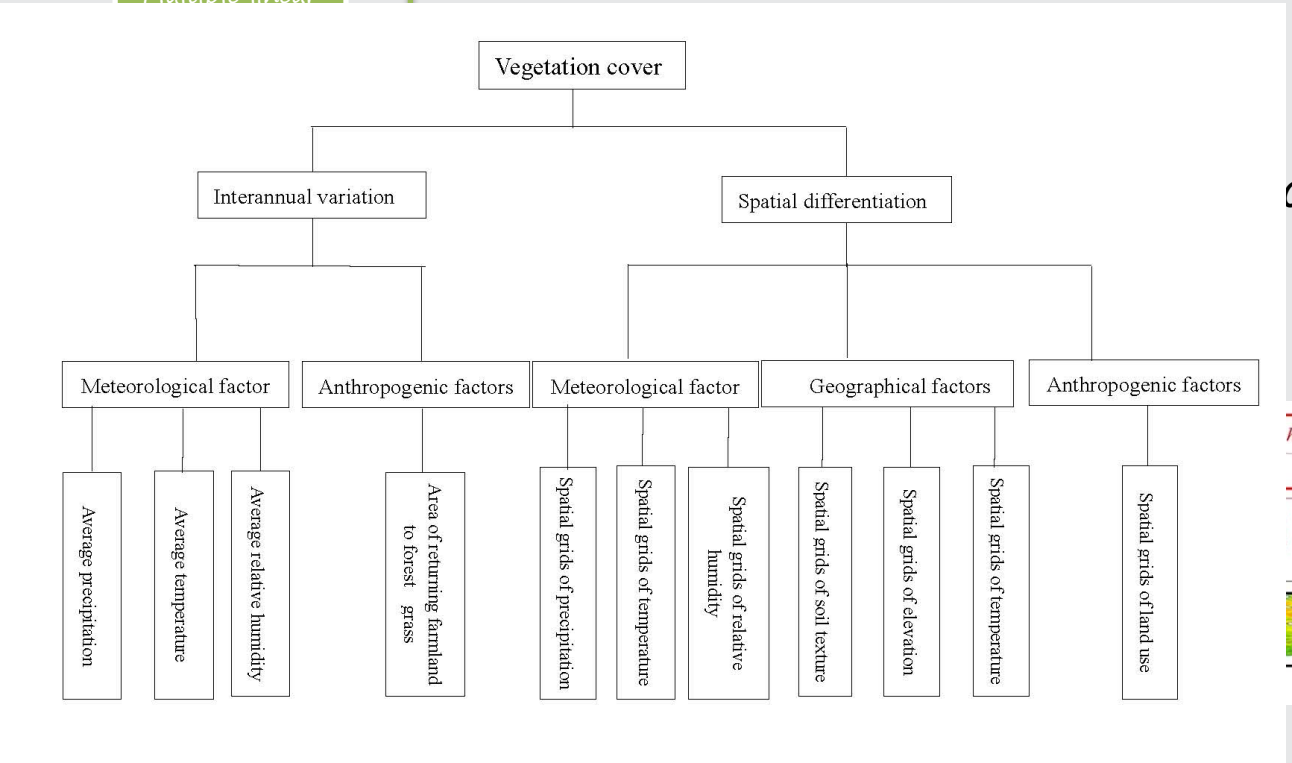
The spatial heterogeneity of vegetation cover is caused by the differences in the spatial distribution of meteorological factors, geographical factors, and anthropogenic factors in the region

•Investigating the spatial and temporal distribution of vegetation cover and its dominant factors can provide a scientific basis for ecological protection and related decision-making in ecologically fragile regions

Spatio-temporal Changes and Influencing Factors of Vegetation Coverage

Multiple linear

Previous studies



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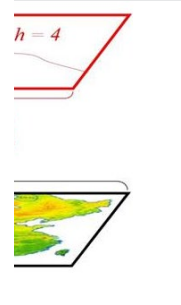
What is a geodete



- A new statistical
  forces behi thi
- **Advantages:** Not
  to consider covar

At present, it is not clear to what extent the vegetation cover has been influenced by natural or human factors in different periods of time and spatial variation respectively since the implementation of the project.

02

Materials and methods

Resarch area

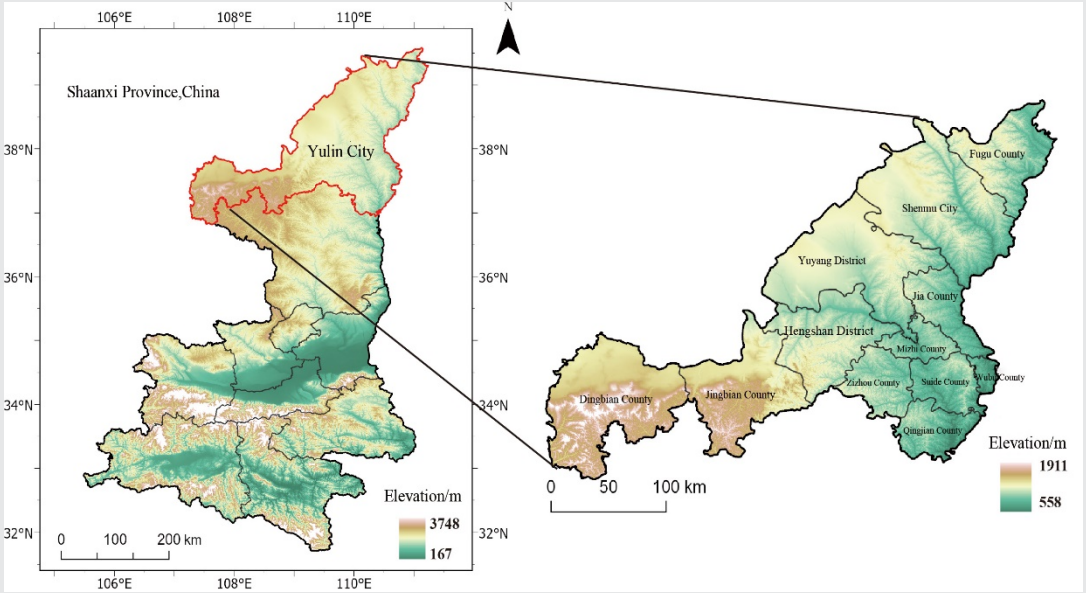


Fig.1 Map of Yulin's geographical location

Yulin City

(107° 28′ -111° 15′ E,36° 57′-39° 34′ N)

- The north-central part of Loess Plateau, one of the most fragile areas in the ecological environment in Loess Plateau.
- With harsh climatic conditions and loose soil, soil hydraulic erosion was easy to occur in summer and wind erosion was easy to occur in spring.

Data sources and pre-processing

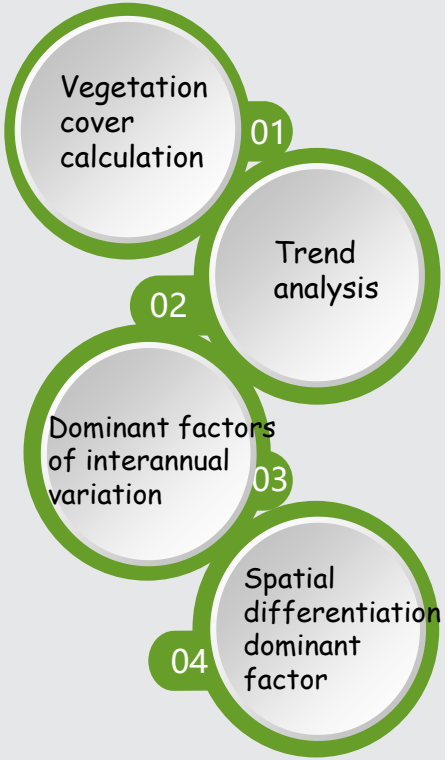
Data type	Data source	Products	Resolution (Time range)	Preprocessing
NDVI	National Aeronautics and Space Administration	Moderate Resolution Imaging Spectrometer--MOD13Q1	250m（2001-2020）	Radiation calibration, format conversion and cropping of MODIS data using MRT, ENVI5.3, ArcGis10.2, resampling to 1km resolution
Elevation, Slope	Geospatial Data Cloud (http://www.gscloud.cn/）	Digital Elevation Model	90m	Stitching, cropping and format conversion with ENVI software, resampling to 1km resolution
Meteorological data	National Weather Science Data Sharing Service Platform（http:/data.cma.cn/site/index.html)	Daily data set of surface climate data in China: rainfall, temperature, relative humidity	16 meteorological stations in and around the study area (2001-2020)	Spatial interpolation of meteorological data with DEM as covariate using AUNSPLIN software to obtain raster images with 1km resolution
Soil texture	Data Center for Resource and Environmental Sciences, Chinese Academy of Sciences（http://www.resdc.cn）	Spatial Distribution of Soil Texture in China Dataset	1km	/
Land Use	Data Center for Resource and Environmental Sciences, Chinese Academy of Sciences（http://www.resdc.cn）	China Land Use Remote Sensing Monitoring Dataset	1km（2005、2010、2015、2020）	/
Cumulative area of "Grain to green"	Office of Returning Farmland to Forest in Yulin City	The area of returning farmland to forest and grass, the area of reforestation of barren mountains	2001-2020	/

Research Methodolog

Computational principles

$$\text{FVC} = \frac{NDVI - NDVI_{soil}}{NDVI_{veg} - NDVI_{soil}}$$

$$\text{FVC} = \frac{NDVI - NDVI_{min}}{NDVI_{max} - NDVI_{min}}$$



$$S = \frac{n \times \sum_{i=1}^{n} i \times FVC_i - (\sum_{i=1}^{n} i)(\sum_{i=1}^{n} NDVI_i)}{n \times \sum_{i=1}^{n} i^2 - \left(\sum_{i=1}^{n} i\right)^2}$$

$$R_{xy \cdot z} = \frac{R_{xy} - R_{xz} \cdot R_{yz}}{\sqrt{(1 - R_{xz}^2)(1 - R_{yz}^2)}}$$

$$q_{f,FVC} = 1 - \frac{\sum_{i=1}^{L} N_i \sigma_i^2}{N\sigma^2} = 1 - \frac{SSW}{SST}$$

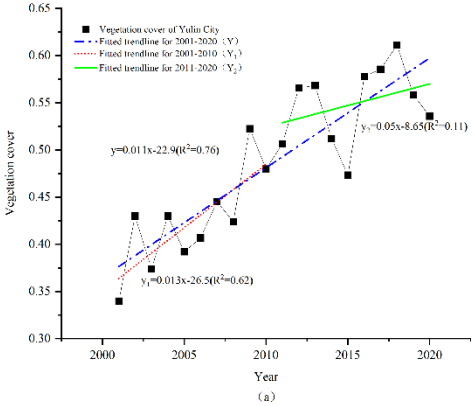
$$SSW = \sum_{i=1}^{L} N_i \sigma_i^2 \qquad SST = N\sigma^2$$

03

Research results and analysis

Spatial and temporal variation characteristics of vegetation cover in the context of returning farmland to forest and grass

Temporal variation characteristics of vegetation cover



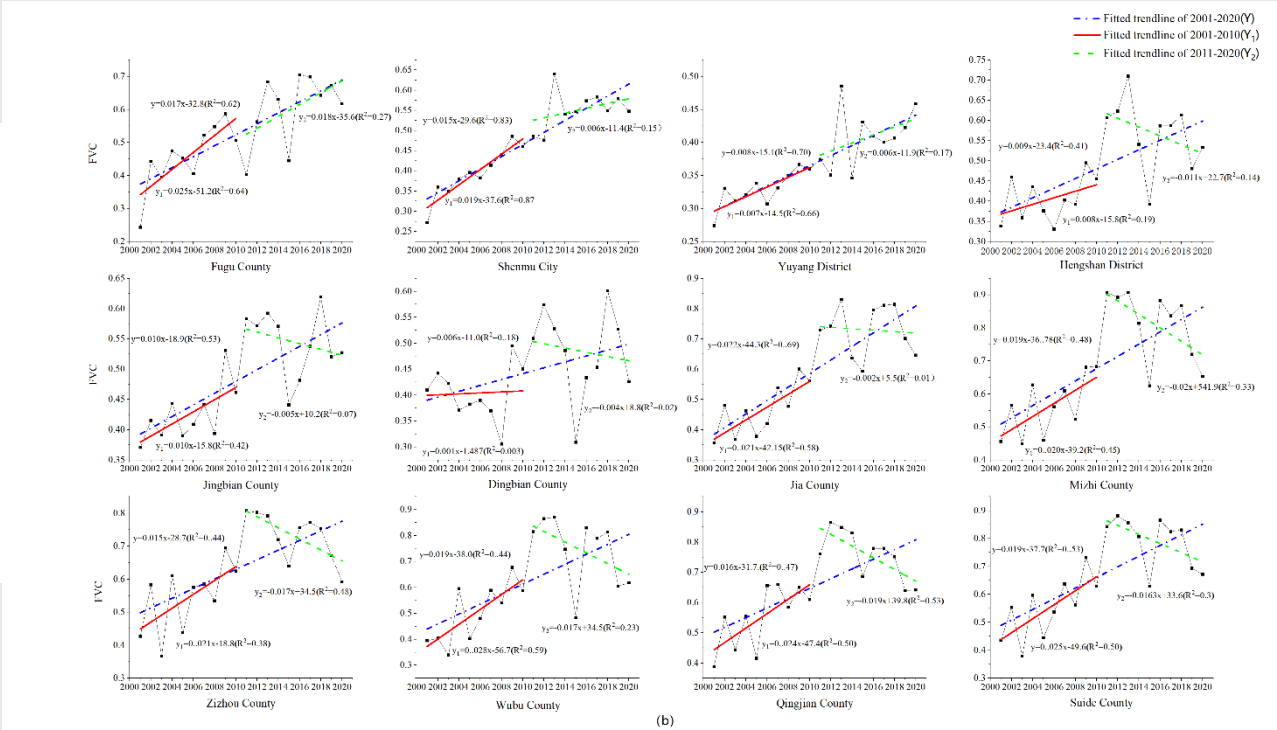


Fig. 3 Interannual trends of annual average vegetation cover in Yulin (a) and each county (district) (b)

Spatial and temporal variation characteristics of vegetation cover in the context of returning farmland to forest and grass

Spatial distribution and trend characteristics of vegetation cover

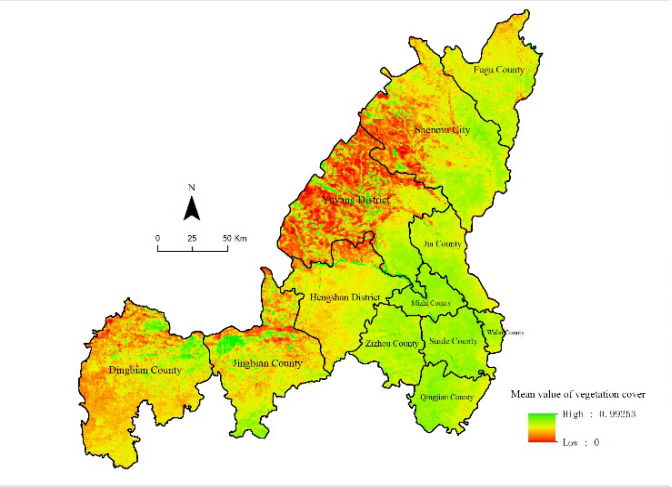


Fig. 4 Spatial distribution of average annual vegetation cover in Yulin City from 2001 to 2020

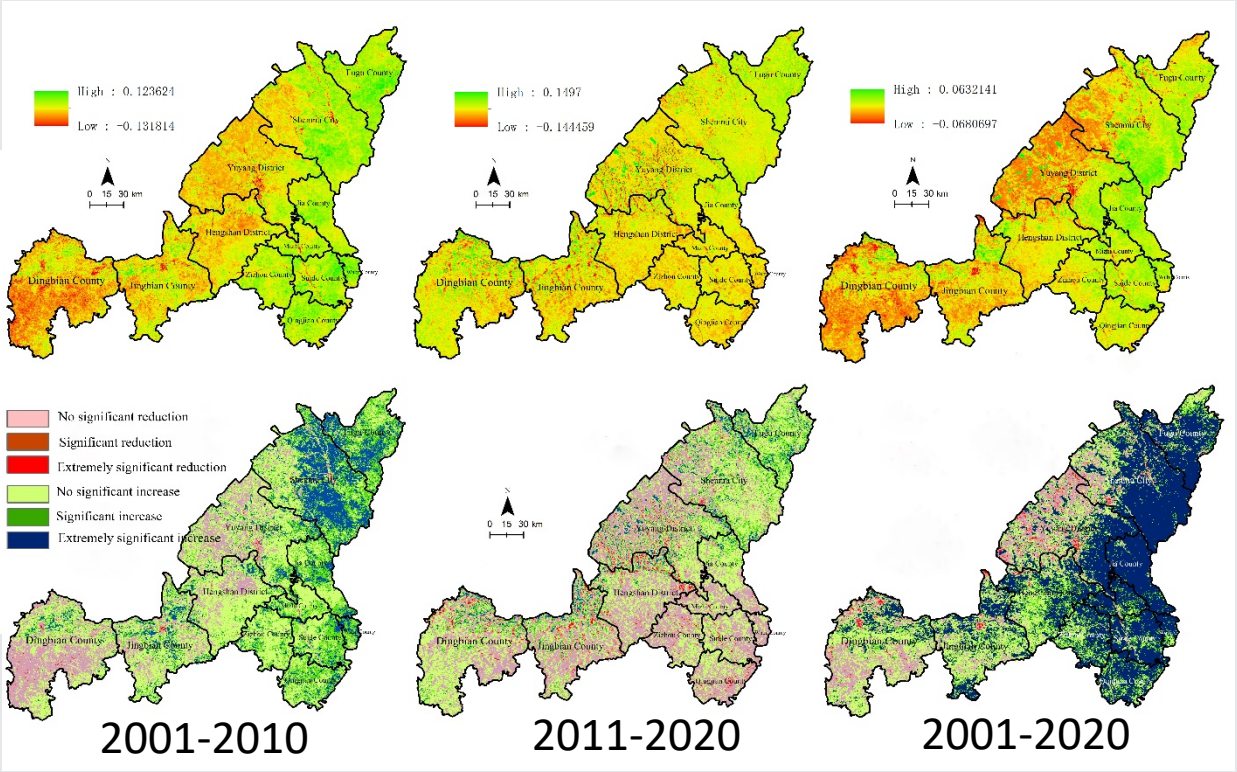


Fig. 5 Trends and significance tests of vegetation cover changes in Yulin from 2001 to 2020

Analysis of factors influencing vegetation cover in the context of Grain for Green" program

Dominant factors of interannual variation in vegetation cover

Fig. 4 Spatial distribution of average annual vegetation cover in Yulin City from 2001 to 2020

Factors	Construction Period (2001-2010)		Consolidation period (2011-2020)		2001-2020	
	Bias correlation coefficient	P-value	Bias correlation coefficient	P-value	Bias correlation coefficient	P-value
Precipitation	0.175	0.68	0.85**	0	0.59**	0.01
Temperature	-0.07	0.85	0.5	0.17	0.30	0.28
Relative humidity	-0.16	0.67	0.59	0.09	0.38	0.10
Area of returning farmland to forest (grass)	0.71*	0.05	0.22	0.63	0.86**	0.00

*indicates significant correlation (P<0.05),
** indicates highly significant correlation (P<0.01)

Table. 1 Biased correlation analysis of vegetation cover and influencing factors

Analysis of factors influencing vegetation cover in the context of "Grain for Green" program

Dominant factors of spatial variation in vegetation cover

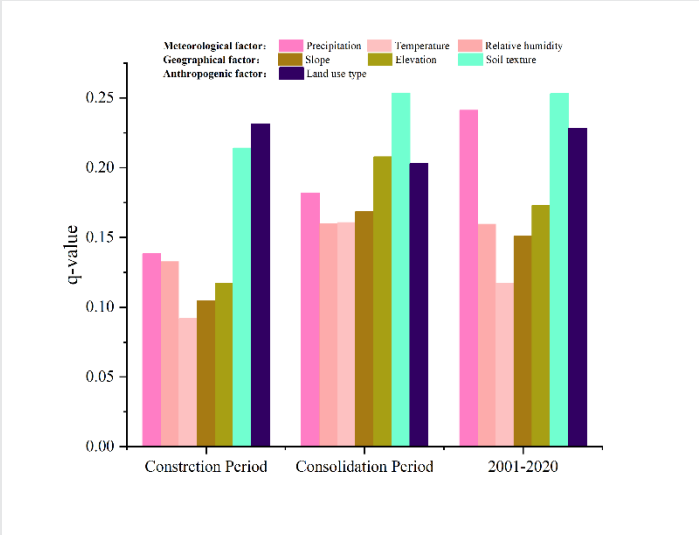


Fig.5 Results of vegetation cover factor detectors at different stages

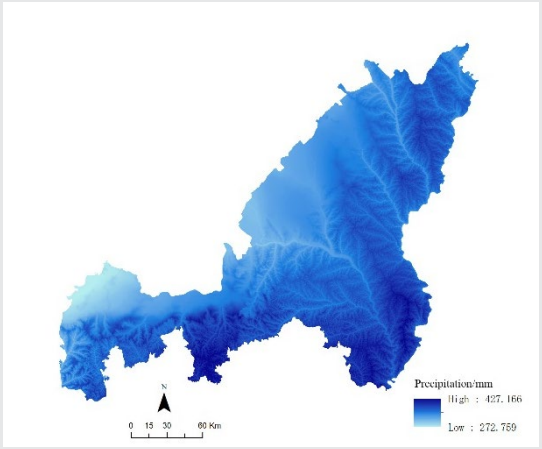
2001-2020	Rainfall	Relative Humidity	Temperature	Soil texture	Slope	Elevation	Land use type
Rainfall	0.241[a]						
Relative Humidity	0.331[b]	0.160[a]					
Temperature	0.327[b]	0.231[b]	0.117[a]				
Soil texture	0.387[b]	0.311[b]	0.339[b]	0.253[a]			
Slope	0.301[b]	0.249[b]	0.265[b]	0.289[b]	0.151[a]		
Elevation	0.330[b]	0.244[b]	0.210[b]	0.360[b]	0.306[b]	0.173[a]	
Land use type	0.397[b]	0.325[b]	0.340[b]	0.367[b]	0.324[b]	0.363[b]	0.228[a]
Construction period	**Rainfall**	**Relative Humidity**	**Temperature**	**Soil texture**	**Slope**	**Elevation**	**Land use type**
Rainfall	0.138[a]						
Relative Humidity	0.235[b]	0.133[a]					
Temperature	0.246[c]	0.187[b]	0.092[a]				
Soil texture	0.265[b]	0.265[b]	0.271[b]	0.214[a]			
Slope	0.262[c]	0.187[b]	0.198[b]	0.239[b]	0.104[a]		
Elevation	0.16[b]	0.181[b]	0.136[b]	0.276[b]	0.213[b]	0.117[a]	
Land use type	0.315[b]	0.309[b]	0.305[b]	0.347[b]	0.305[b]	0.311[b]	0.231[a]
Consolidation period	**Rainfall**	**Relative Humidity**	**Temperature**	**Soil texture**	**Slope**	**Elevation**	**Land use type**
Rainfall	0.182[a]						
Relative Humidity	0.34[b]	0.16[a]					
Temperature	0.288[b]	0.26[b]	0.161[a]				
Soil texture	0.446[c]	0.315[b]	0.366[b]	0.254[a]			
Slope	0.345[b]	0.278[b]	0.311[b]	0.299[b]	0.169[a]		
Elevation	0.314[b]	0.284[b]	0.248[b]	0.395[b]	0.33[b]	0.185[a]	
Land use type	0.387[c]	0.311[b]	0.354[b]	0.35[b]	0.313[b]	0.38[b]	0.203[a]

Table.2 Interaction detector results

04

Discussion and conclusion

Discussion



Time Scale

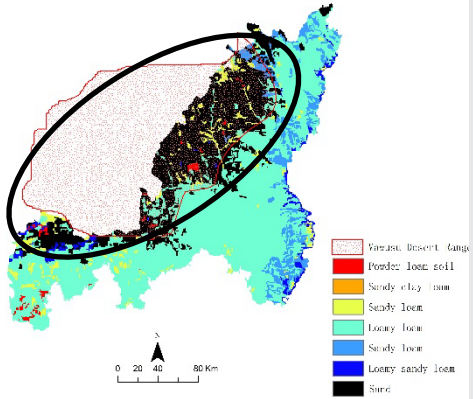
Cumulative area of fallow grass/Rainfall

- Implementation of the "Green for Grain"Project
- Arid and semi-arid areas, constrained by moisture conditions

Soil texture

Soil texture is unevenly distributed, the western side is located in the Mawusu sandy area, mainly distributed in sandy soils with a sand grain content of more than 85 percent

Spatial scale



Factors influencing vegetation cover changes in different periods and their interaction

Construction Period

Time scale:

Cumulative area of fallow grass

The direct effect of implementation of the "Green for Grain" Project

Spatial scale:

Land use type

The implementation of the project of returning farmland to forest and grass directly changed the land use structure

Interaction:

Rainfall & Slope

The hilly and ravine areas in the eastern part of Yulin (>25° sloping arable land with fallowing policy)+ the distribution of more rainfall in the eastern

Consolidation Period

Time scale:

Rainfall

Vegetation growth requires good water and heat environment

Spatial scale:

Land use type

Vegetation growth requires adequate nutrient maintenance

Interaction:

Rainfall & Soil texture/Land use type

Rainfall concentrated in July and August and mainly in the form of heavy rainfall + sparse or non-vegetated land with poor soil texture, which is highly susceptible to soil hydraulic erosion

Prospects

Vegetation Restoration Practice Guidance

The spatial heterogeneity of vegetation distribution and the interaction between the main influencing factors need to be fully considered

- Poor vegetation cover: reduce human interference and carry out vegetation restoration with grasses and shrubs as appropriate, taking into account soil texture and water conditions.
- Better vegetation cover: increase plant species and biodiversity under the premise of ensuring normal reproduction of existing plants.

- The large-scale vegetation restoration project has caused an increase in regional water consumption and evapotranspiration, which in turn has affected the regional hydrological balance.
- Attention should be paid to the selection of water-saving and drought-resistant tree species, the adjustment of afforestation density to ensure the sustainability of vegetation restoration.

Arid climate and extensive forest plantations have led to a slowdown in the upward trend of vegetation cover

Sustainability of vegetation restoration

End of report, Thanks for listening