◆Research Paper

Study on Soil Erosion in Ansai County of Shanxi Province

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Abstract: Ansai country in Shanxi province is located in the plateau of the northwest inland. Its unique characteristics, terrain slope and summer rainy climate conditions, and severe agriculture and human activities, all lead to serious soil erosion in the region. For the soil condition of the Ansai country, this paper uses ArcGIS software to research gully density, and using WEEP software analyze the factors of the rill erosion which is the main way erosion of Ansai country. Then the results show that the soil erosion of each area is very serious, belong to intense level. And the soil erosion in each cultivated area gives a significance guiding for soil conservation.

Key words: Macro monitoring extraction; Gully density; Model simulation; Rill erosion

Introduction

Ansai country in Shanxi province is located in the plateau of the northwest inland, is located in the Ordos basin edge. The geographical location of Ansai country in Shanxi province is shown as figure 1. Its unique characteristics, terrain slope and summer rainy climate conditions, and severe agriculture and human activities, all lead to serious soil erosion in the region. Soil and water loss can lead to land degradation, soil fertility decline, arable land decrease. And it hinders the sustainable development of the society too. Because the soil erosion for the loess plateau is so serious, soil erosion dynamic observation condition is urgently needed. Foster (1986) make the gully erosion as a separate erosion type to study. Meyer (1975) and Foster (1972) believe there is critical flow in the occurrence of rill erosion process, once it arrived at the slope surface critical flow, rill erosion will occur, and they has established the model which is used to calculate the critical flow rate of rill erosion occurs.

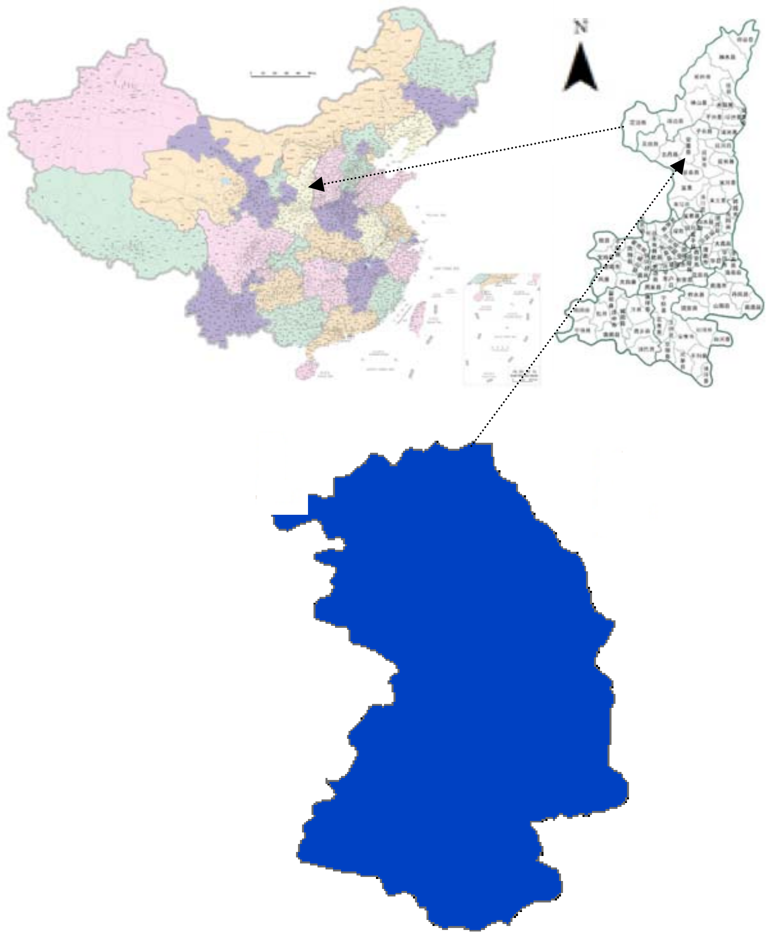

Figure 1 The location of Ansai country in Shanxi Province and the location of Shanxi Province in China

Gully Density

For the soil condition of the Shanxi province, this paper uses ArcGIS software to research, and using WEEP software analyze the factors of the rill erosion which is the main way erosion of Ansai country. The soil erosion macroscopic observation needs 3S technology, using elevation data and ArcGIS software to analyze the DEM data that the resolution is 30 meters. Then using ArcGIS software to extract the no depression basin, the flow direction, the cumulative flow, lattice vector quantization river, generate river network connection, generate the catchment basin, determine the drainage basin, area mainly classification and each area gully density extraction. The partition area is shown as figure 2. Then analyze every area gully density. The gully density results are shown as table 1. Then compare the area gully density with the standard (SL190-2007) of the gully erosion classification standards, which is divided into mild, moderate, strong erosion strength, very strong and intense all levels, and results show that the soil erosion of each area is very serious, belong to intense level. The standard (SL190-2007) of the gully erosion classification standards are shown as table 2.

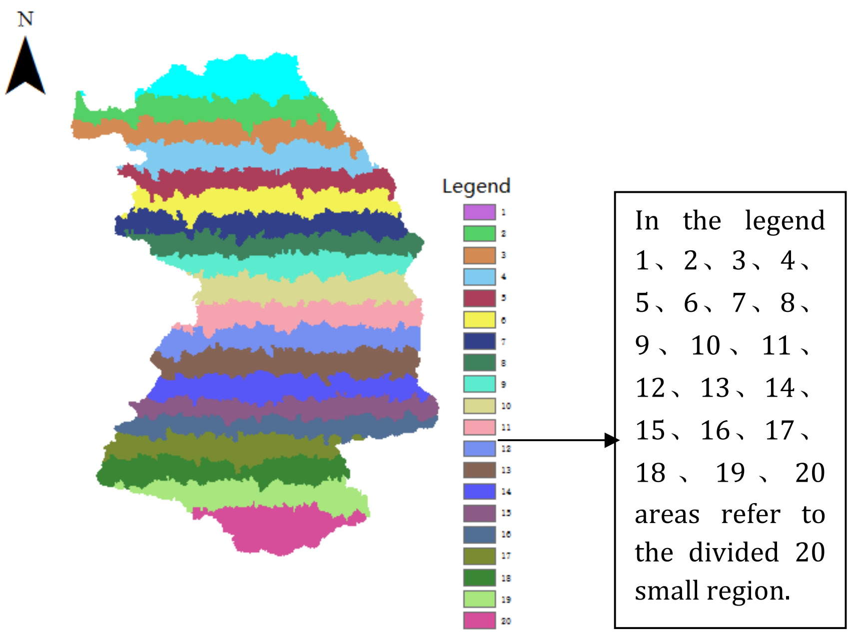

Figure 2 20 small area of Ansai country

Table 1 The valley gully density of Ansai country 20 small area

Area code	Region areas(km^2)	Erosion gully length(km)	Erosion gully article number	Gully density (km/km^2)
Area-1	172.66	1428.96	207	8.27
Area-2	167.19	1521.60	217	9.1
Area-3	187.93	1575.61	233	8.38
Area-4	159.27	1632.19	220	10.24
Area-5	148.02	1583.78	224	10.69
Area-6	173.13	1631.26	220	10.24
Area-7	158.58	1643.31	225	10.36
Area-8	135.48	1485.61	212	10.96
Area-9	117.61	1399.73	200	11.90
Area-10	127.83	1506.30	211	11.78
Area-11	137.93	1512.38	216	10.96
Area-12	153.30	1644.66	229	10.72
Area-13	159.44	1835.03	234	11.50
Area-14	143.23	1787.34	234	12.47
Area-15	149.81	1584.81	216	10.57
Area-16	157.67	1559.10	209	9.88
Area-17	165.82	1492.26	224	8.99
Area-18	131.58	1695.30	223	12.88
Area-19	154.79	1603.78	218	10.36
Area-20	129.41	1326.37	177	10.24

Standard (SL190-2007) of the gully erosion classification standards describe as table 2:

Table 2 Hierarchical classification standard of soil erosion

Strength analysis	Mild	Moderate	Strong	Very strong	Intense
Gully density(km/km^2)	1-2	2-3	3-5	5-7	>7

Then the results show that the soil erosion of each area is very serious, belong to intense level. Soil erosion of Ansai country is very serious.

The Model Simulation of Rill Erosion

Because rill erosion of the sediment content is about 70% of the whole river basin, the rill erosion is the main soil erosion on the loess plateau. The WEEP software is a water erosion model which is mainly used to simulate rill erosion. Input the data of the 2015 climate of Ansai country, soil characteristics, different slope, different slope length and different tillage farming into the WEEP software to simulate the soil erosion. The winter wheat farming area cultivates twice every year, and the depth of tillage is 1.97 inches. Planting winter wheat in Annual, the row width is 47.24 inches, the in-row plant spacing is 0.1968 inches, and the maximum root depth is 59.05 inches. The soybean farming area cultivates twice every year, the depth of tillage is 1.97 inches, the row width is 30 inches, the in-row plant spacing is 0.9842 inches, and the maximum root depth is 39.37 inches. The corn farming area cultivates twice every year, the depth of tillage is 2.00 inches, the in-row plant spacing is 8.622 inches, and the maximum root depth is 59.84 inches. The grass farming area cultivates twice every year, the row width is 0.00 inches, the depth of primary tillage layer is 7.874 inches, the depth of secondary tillage layer is 3.937 inches. The fallow farming area cultivates twice every year, the depth of primary tillage layer is 7.874 inches, and the depth of secondary tillage layer is 3.937 inches. The specific parameters of each farming area in WEEP model show as table 3 and table 4. The rill erosion results are shown as figure 3, 4, 5, 6, 7.

Table 3 The parmeters of winter wheat and corn and soybean area in WEEP

Parmeter	Winter wheat	Corn	Soybean	Units
Biomass energy ratio	0.08141	0.08141	0.0535	1bs/btu
Growing degree days to emergence	140	131	140	Degrees F. day
Growing degree days for growing season	3092	3092	2102	Degrees F. day
In-row plant spacing	0.1968	8.622	0.9842	inches
Plant stem diameter at maturity	0.252	2.008	0.374	inches
Height of post-harvest standing residue: cutt	5.984	11.97	5.984	inches
Harvest index(dry crop yield/total above growth)	40	50	50	%
Base daily sir temperature	37.4	50	50	Degrees F
Optimal temperature for plant growth	59	77	77	Degrees F
Maximum temperature that stops the growth of	32	32	32	Degrees F
Critical freezing temperature for a perennial	32	32	32	Degrees F
Radiation extinction coefficient	0.65	0.65	0.31	-
Canopy cover coefficient	5.2	3.6	14	-

Parameter value for canopy height equation	3	3	3	-
Maximum leaf area index	5	102.4	5	inches
Root to shoot ratio(% root growth/% above growth)	25	25	25	%
Maximum root mass for a perennial crop	0	0	0	1bs/acre
Percent of growing season when leaf area index	80	85	90	%
Period over which senescence occurs	14	30	14	days
Percent canopy remaining after senescence(0-100%)	100	65	10	%
Percent of biomass remaining after senescence	100	98	10	%
Parameter for flat residue cover equation	0.00061	0.00026	0.00058	acres/1b
Standing to flat residue adjustment factor	99	99	99	%
Decomposition constant to calculate mass chan	0.0085	0.0065	0.013	-

Note 1: '-' in the Units denotes the data is constant, there is no unit.

Table 4 The parameters of grass and fallow area in WEEP

Parameter	Grass	Fallow	Units
Bulk density after last tillage	1.1	1.1	(g/cub.cm)
Initial canopy cover(0-100%)	50	0	%
Days since last tillage	200	200	days
Days since last harvest	92	2000	days
Initial frost depth	0	0	inches
Initial interrill cover(0-100%)	50	0	%
Cumulative rainfall since last tillage	19.69	19.69	inches
Initial ridge height after last tillage	0.7874	0.7874	inches
Initial rill cover(0-100%)	50	0	%
Initial roughness after last tillage	0.7874	0.7874	inches
Rill spacing	0	0	inches
Initial snow depth	0	0	inches
Initial depth of thaw	0	0	inches
Depth of secondary tillage layer	3.937	3.937	inches
Depth of primary tillage layer	7.874	7.874	inches
Initial rill with	0	0	inches
Initial total dead root mass	1784	0	1bs/acre
Initial total submerged residue mass	0	0	1bs/acre

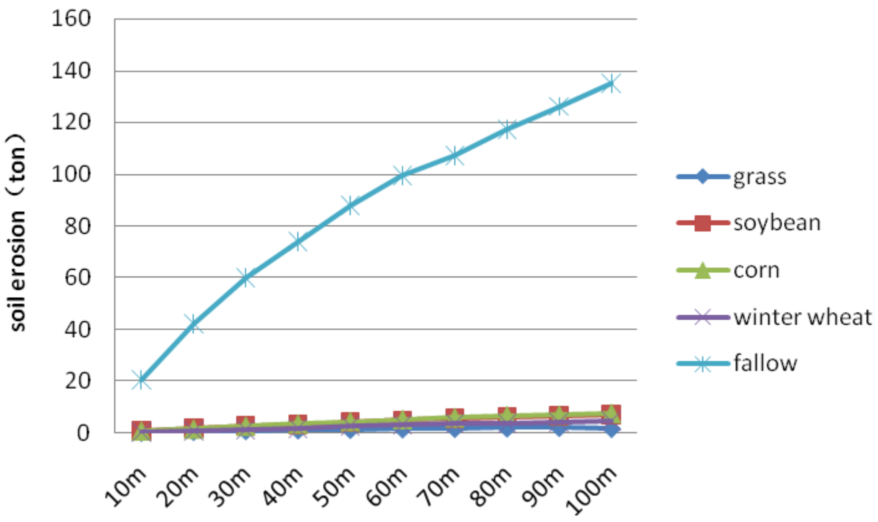

Figure 3 15 degrees slope of different slope length of five farming area (including fallow farming area) soil erosion

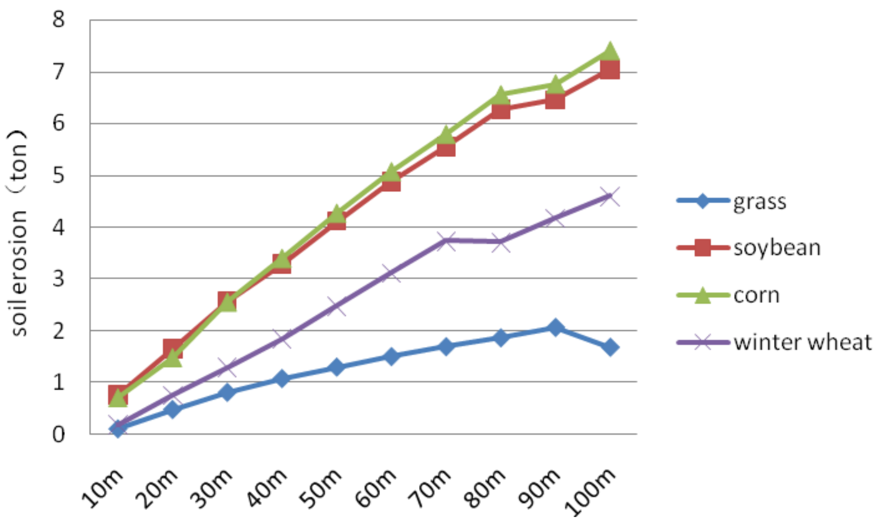

Figure 4 15 degrees slope of different slope length of four farming area (excluding fallow farming area) soil erosion

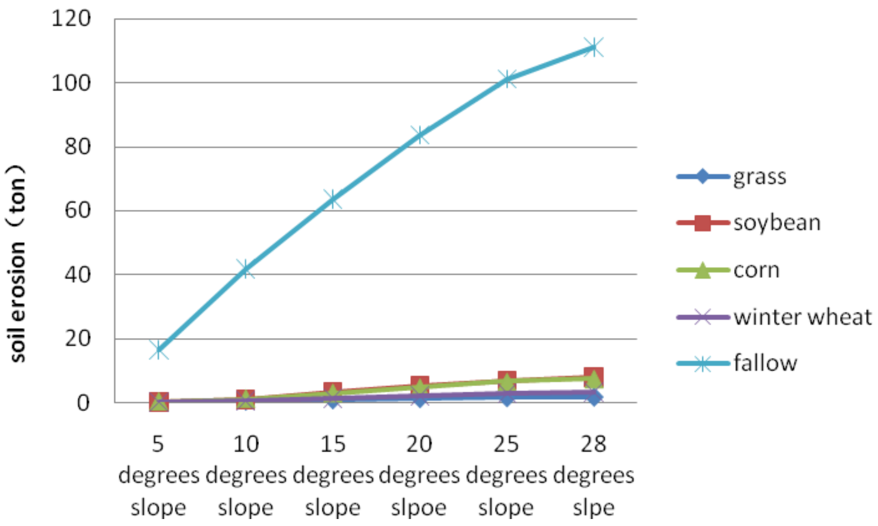

Figure 5 Slope length 25 meters of different slope of five farming area (including fallow farming area) soil erosion

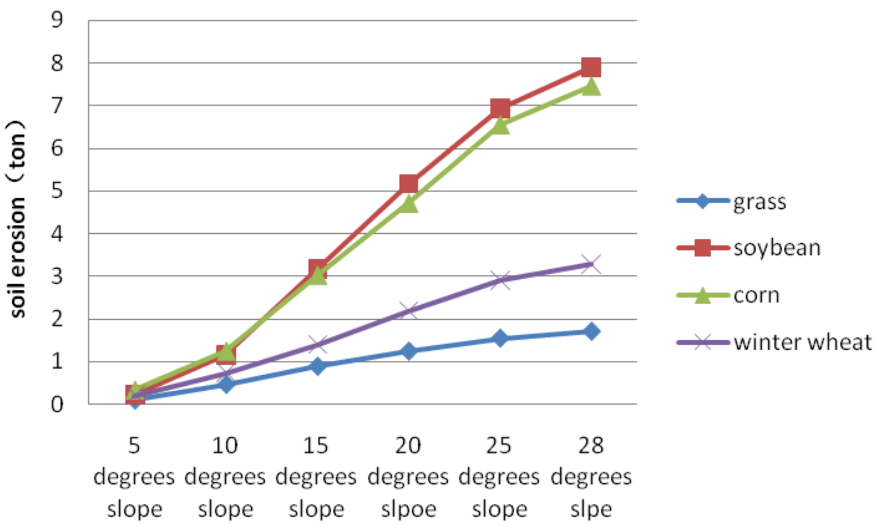

Figure 6 Slope length 25 meters of different slope of four farming area (excluding fallow farming area) soil erosion

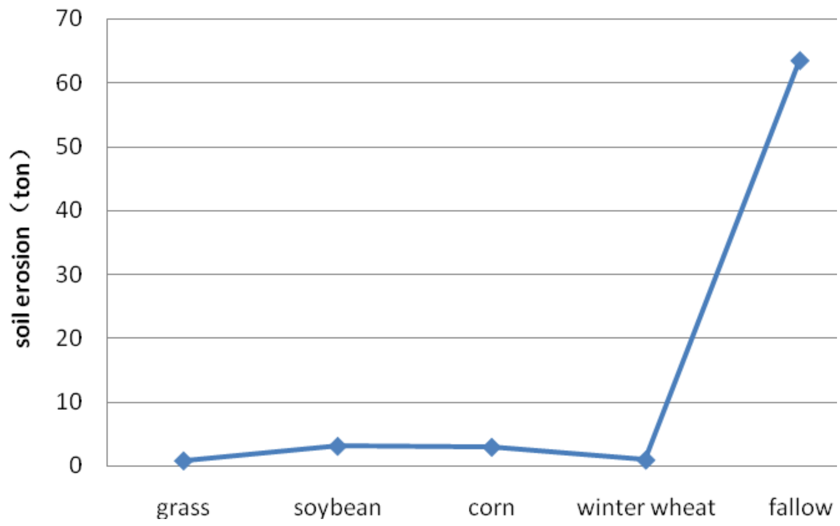

Figure 7 25 meters slope gradient 15 degrees of different cultivation areas soil erosion

Under the same conditions, the smallest soil erosion is the grassland farming area, then winter wheat cultivation area of soil erosion is greater than the grassland farming area, soybeans and corn crop cultivation area of soil erosion is approximately the same and is greater than the soil erosion of winter wheat crop farming area, finally, fallow cropping area without any crop cultivation area of soil erosion is the largest. Therefore, the soil erosion of vegetation protection soil is far less than the fallow crop protection farming area, therefore, the crop protection is very important to control soil and water conservation.

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