

The Research on Relation Between Land Resource Utilization and Water and Soil Conservation in Developing the West of China

*Di Li*¹, *Lei Sheng-wen*², *Sun Pen-ju*³ and *Zhang Li-ping*⁴

¹Collage of Forestry, Gansu Agricultural University

E-mail: jiarui@public.lz.gs.cn

²GanSu Provincial Bureau of soil and Water Conservation

³GanSu Provincial Bureau of Land Manage

⁴GanSu Institute of Soil and Water Conservation

Abstract: This paper is according to the question about the land resources utilization and the situation of soil and water erosion in the west under today's social economy conditions, discussing what is reasonable land utilization and what is unreasonable land utilization. We think with the development of the social economy land resources would be tend to multiplex. At the beginning of exploiting and using land resources, the key to resolve the land resources reasonable use is to the controlling work of soil and water conservation.

1 Land resource and land utilization

Land is the basis on which people live and produce. The social and economic development depends on sustainable land utilization. The land resources is one of the basic regional resources on which the social and economic development depends, the natural composite formed by interaction of all kinds of components (climate, hydrology, geology, landforms, soil, vegetation) which constitute land. Including the effect of artificial activities in the past and at present, it has functions in both production and environment .its ecological significance plays a very important role in sustainable land utilization.

It is the land resources utilization, for people's living and developing, that people exploit, manage, administer and protect land. It is the product of nature and society. It emerged when human being existed, and stressing the depth and scope with the human society development. 《Technology rules used to investigate the status quo of land utilization》 issued by National Agricultural Plan Committee in 1984, employed two-grade classification system to classify the status quo of land utilization. There are 8 kinds in first grade, cultivated land, park area, woodland, grazing land, residential area, industry and mining land, the land used to traffic, water area, the land which had not been used. There are 46 kinds in second grade, we can also employ three or four-classification system based on actual circumstance in various region. The population in our country compared with developed country is increasing very quickly. Therefore the contradiction between the increaing needs in social economy and the rarity of land natural resource is increasely acute. The manifestation of the contradiction are as follows: one is the competition in all kinds of using, for example, the good cultivated land is taken up by industry and mining area, therefore the productivity of grain is influenced. The woodland, and grazing land is cultivated, the developing of forestry and animal husbandry is impaired. For example, the land resource investigation conducted respectively in Xifeng urban of Gansu province in 1981 and 1990 showed that cultivated land decreased 2,732 km², grassland increased 7,333km², residential area increased 5,067 km², the woodland increased 2,867 km², park land increased 800 km² (see Table 1). The analysis indicates:that caves changed into one-story house, it is the main cause to bring about the cultivated land to decrease that the residential area was built on highland The following investigation of land area used to construct urban in Xifeng urban indicated that the newly increased construction area is 265 km², the percent age is 33 in total construction area of the urban. Abandoned old cave dwelling caused land going out of cultivation, the soil erosion getting serious. The second contradiction exists among social benefit, economic benefit and ecological benefit such as setting up developing area blindly by abandoning cultivated land to enclose

land, and making brick and tilt by abandoning cultivated land to get earth. These practices change 1,000,000 mu fertile farmland into wasteland, and cause erosion every year.

Table 1 The analysis of land utilization in xifeng urban (unit hm²)

Year	Cultivated land	Park area	Grassland	Woodland	Residential area	Not have been utilized area	General area
1981	43,933	800	40,666	3,200	5,600	3,333	99,667
1990	41,200	1,600	33,333	6,067	10,667	5,133	99,467
90vs.81	-2,733	800	-7,333	2,867	5,067	1,800	-200

2 The status quo of natural condition and erosion in western area

Large parts of western area located in arid region whose Precipitation ranges from 300mm to 550mm, and arid degree varies from 1.5—3.0, natural condition is bad, ecological circumstance is fragile and erosion is serious in these areas (see Table 2). We can get the conclusion from the table two that Shannxi, Shanxi, Gansu is the largest in the erosion area added up to 290,500km² in the three provinces, the percentage is 68.3 in total erosion area, Gansu province is the largest in erosion area proportion.

Table 2 The erosion and harness area in main western provinces(unit hm²)

Province	total land area	Erosion area	erosion percent	area not have been harness
Gansu	109,665	94,268	85.96	67.813
Shanxi	156,465	96,503	61.68	57.983
Neimenggu	123,261	59,527	48.29	48.331
Ningxia	51,857	39,176	75.55	34.080
Qinghai	34,415	23,717	68.91	62.094
Shannxi	129,710	99,729	76.89	62.094
Guizhou	176,128	76,682		

3 The relation between different land utilization state and erosion

Vegetation, topography, soil, precipitation and the land utilization are five main factors influencing erosion. The form of land utilization have many styles, but they can be grouped into two styles. The reasonable style refers to the effect of land utilization, depends on whether it have realized the benefit unification of economic, ecological and social benefits. The rationality is obvious. The unreasonable style is difficult to understand, because differences exist in understanding. For example, the engineering project of exploiting mine, constructing factory and road, making brick, etc. is increasing every year with economic development. After destroying greatly the vegetation and land form, these projects always cause erosion, therefore some people classify these forms of land utilization into unreasonable style. But we think these forms of land utilization is reasonable, because economic development needs these project, and these project were programmed before carrying out. Only in some area, people are driven by present benefit, attaching great importance to economic construction, belittling ecological circumstance construction, didn't restore the vegetation and the landform destroyed timely and dumped waste soil, abandoned stone, slay. Thus the erosion was caused by coal mine, chemical plant, metallurgy plant. By preliminary estimate waste soil discharged amounted to 14,000,000 t in Shannxi province not including large-size mine. These waste soil which can be used account for only percent 8, others discharged into nearby ditch ,Shuanglong ditch gold mining area, in Tianzhu county in Gansu province, has been

exploited large-scale since 1983, which has made 20km riverbed destroyed, heaped sand stone everywhere, made erosion serious, increased sand deposition in river. The deposition were 2,800,000m³ every year, from 1960 to 1984, 230,000 m³ every year, 2.7 times compared with that before mining, from 1985 to 1991, increasing deposition 1,800,000 m³, depositing 30,000 m³ every year, 2.5 times before gold mining from 1992 to 1997. These two examples show that reasonable utilization also can cause water and soil erosion. This erosion form need to be controlled through harnessing and exploiting, we must plan synchronic and carry out the plan step by step.

The population in our country is large, while the cultivated land is few. Only 11 percent suitable for cultivating. The per capita cultivated land only account for percent 27 of the world average level. The total cultivated land area was 1.468 billion mu in 1949, and extended to 1.677 billion mu in 1957, diminished gradually every year after 1957. The total diminishing area accumulated to more than 0.62 billion mu to 1990, diminished 7.6 million mu on average every year, higher than developed country. Our country have controlled the diminishing range of cultivated through carrying out great measures to prevent abusing and taking up cultivated land, fully strengthen the land management. However the cultivated land diminished quickly due to increasing population and economic development. The area amounted to more than 6 million mu in 1993 and 1994, the highest diminishing speed year from “The sixth five-year”. The cultivated area destroyed by all kinds of natural disaster increased greatly when the area of recovering cultivated land and cultivating virgin land decreased, per capita cultivated land were 1.5 mu in 1979, decreased to 1.3 mu in 1989, only 1.2 mu in 1993. Our country is experiencing the economic climax, in which the land used in industry and city increasing year after year, population increasing by percent 1 year after year, therefore the trend of cultivated land diminishing, especially per capita cultivated land, is difficult to control. This circumstance led to cultivate virgin land blindly, even on steep slope, in some region, especial western region where natural condition is bad, for people carried out some short-term action at present disregarding long-term production for the benefit in the long run, such as mining blindly, accelerated the soil degeneration and caused erosion, dumping waste and abandoned earth will caused erosion too. People in some region where population density is not very high and per capita cultivated land area, amounts to 0.7km or so, cultivate excessively slope land, sow extensively but harvest is small, which is wasting and destroying land resource purely. In central and western region of Loess Plateau, the land can meet the needs of planting industry where the ground slope is small, less than 20° for the most part. If we reclaim waste land in the region where the slope is more than 20°, we will cause more serious erosion (see Table 3). The main way to solve living problem of more and more people is to enlarge cultivated land, even on steep slope, in western region where economy is backward, science and technology level is low in agriculture, natural disaster is frequent, the land productivity is low. People think that the only way to realize the expanded reproduction is to cultivate virgin infinitely to enlarge grain production area, under the influence of the conception to conquer nature, the policy encouraging to reclaim wasteland and the traditional agricultural production form. According to the investigation in central and western 14 provinces (administrative region, city) involved in reverting cultivated land to woodland and grassland on sloping land, there are 158 million mu sloping cultivated land which the slope is more than 15°—25° percent 16.8 in total cultivated land area, which the slope is the main place of erosion, where the erosion degree is 1 t/(km² · a)—5,000 t/(km² · a) generally, equal to 10 times compared with woodland and 3–6 times compared with other using land. The second national soil investigation indicated that our country erosion area were 2,046 billion mu, percent 34.26 in total cultivated land area, mainly in Loess Plateau region and southwest region. The investigation also indicated that the silt run off every year were 5 billion ton, in which there were 6,810.839 million mu cultivated land. The cultivated land area in Gansu province increased 17,500 ha after comparing the detailed investigation data and the approximate investigation data, the elevation of cultivated land achieved 300m, and there were 302,900 ha cultivated land in the slope more than 25°. There should be certain proportion animal husbandry using land maintained, thought from climate condition and people’s management habit in this region. It is unreasonable using land that we expanding cultivated land blindly, taking up partly animal husbandry using land attaching importance to economic benefit only in policy, violating the principle to suit measures to local conditions to develop highland and flat country, two basic farm land, into orchard and residential area, then to ask for grain in sloping land suitable develop orchard. It is also unrational using land that we discard cultivated land and enclose it to

construct developing region. According to newspaper, almost every village and town has constructed developing region since 1992. All national developing region taken up land 150 million km², in which most developing regions are constructed only not developed and then made a great deal of land going out of cultivation, eroded. The real area developed were 370 km in 150 million km² land taken up by developing region. in which 90 percent are fertile land, abandoned plough, removing soil, and making brick transform 10 million mu fertile lands into wasteland, which result in water and soil erosion. In addition, some data shows that the plunging form management of land such as overgrazing, cutting wood and digging medicinal materials formed water and soil erosion which was is very difficult to restore and belonging to unrational utilization. Besides, some abuses exist in the management. Our country's lands are publicly—owned and managed in the contraction form. Because contraction has limit, the investment of the contractors in land are very limit which make land resource deterioration and water and soil erosion serious. From all above, we can see that water and soil erosion resulted from unrational exploitation of land resources, as natural disaster in ecological system is the one of extremely serious destroying form to sustainable agriculture and more extensive and complex than plant insect and disease, drought and wind disaster.

Table 3 The relation between vegetation and erosion (from Qi Chuhua)

Precipitation slope		270.9 millimeter in floodwater season in 1980					24.5 millimeter on 28,6,1980			
		28°	27°	24°	28°	26°	22°	28°	27°	28°
		Cultivatedland (control)	Grassland (two years old)	Caragana microphyna forest	Robinia pseudoacacia forest (six years old)	Robinia pseudoacacia forest (five years old, living horizontally)	Grazing wasteland and	Cultivatedland (control)	Grassland (two years old)	Robinia pseudoacacia forest (six years old)
Runoff volume	Liter/hectare	237,360.3	105,378.4	15,894.6	16,822.1	1,666.7	184,476.0	20,280	3,677.8	494.3
	Percentage in cultivatedland	100	44.4	6.7	7.1	0.7	77.7	100	18.1	2.4
	Decreased percentage compared with cultivatedland		55.6	93.3	92.9	99.3	22.3		81.9	97.6
Scouring volume	Liter/hectare	44,171.8	1,468.9	80.3	375.2	7.9	10,448.1	3,161.1	21.9	5.6
	Percentage in cultivatedland	100	3.3	0.2	0.9	0.02	23.7	100	0.7	0.2
	Decreased percentage compared with cultivatedland		96.7	99.8	99.2	99.8	76.3		99.3	99.8

4 Reasonable utilization of land resource and water and soil conservation and harness

Firstly, land exploitation provides the product subject of substance demand for huama being to produce large quantity and good quality farm produce and to maintain the demand of national economic survival. Secondly, land exploitation provides living and product place for human being. The land sustainable exploitation is to use, exploit, renovate and protect land resources scientifically and rationally, to realize sustainable use of land resources and coordinate development between society, economic and environment and to meet the demand of social and economic development and to attain the best social, economic and ecological benefits. The first goal of soil and water protection is to harness water and soil erosion, to protect soil productivity, to restore and rebuild the land degeneration resulted from soil and water erosion and to realize the sustainable use of land resource. The second goal is to harness river, to prevent flood and sand deposition and to guarantee the people's safe production and living in lower

reaches. The third goal is to improve vegetation coverage and natural ecological environment, and to realize the sustainable development of agriculture.

Cultivated land, forests land and grassland are the main form of agricultural land use. This three use form provide the primary need for human being. Meanwhile they change the natural ecological environment, in the western area, under actual condition of arid climate, little cultivated land and forest land and high rate of suitable grazing land, exploitation and use of land resources should follow the ecological law and the principle of ecological system health development, Premier Zhu puts forward the 16-word guiding principle of individual contract reverting farm land into forest land, relieving people by providing them with grain. Closing mountain and making it green is very important to adjust land use structure, expand the proportion of forest land and grassland, decrease water and soil erosion and improve the extremely deteriorated ecological environment, planting pasture and bush in reverted cultivated land to develop animal husbandry is consolidation to the reverted cultivated land. In small drainage-basin of Lumacha in Gansu, Dingxi county, the ratio of cultivated land, forest land and grass land, after comprehensive harness from 1984 to 1986, adjusted from 90.1:1.2:8.7 to 40.2:16.9:42.9, the proportion of cultivated land and grass land area increases gradually in recent years. Biological measure of two soil and water protection measure to decrease the quantity of soil and water erosion through increasing vegetation coverage. Different vegetation coverage condition has different soil and water erosion ratio, therefore, coordinately disposing agriculture, forestry, animal husbandry according to ecological law and economic law is the core of rational exploitation of land resources in western region. The common characteristic of terraced fields, suppressed fields and level terrace project between farm land of project measure is to shorten slope length, to decrease runoff, to increase the permeation of precipitation, to protect soil and water and promote biological productivity, produce multiple effect of living thing and economic effect. The project is demanded to be managed in fields easily. Besides the field project, there are water conservancy projects to protect soil and water erosion, such as reservoir, silt dam, storing flood to irrigate, water pool and so on. Some functions of them are to stop flood and hold back mud, form and fertilization fields, store water for irrigation. Therefore those projects have multiple function to utilize land and harness the water and soil erosion.

Chelu ditch of Baiyin urban planted apple trees, pear trees, haw trees, grape trees and strawberry trees, etc, on ditch and dam land, taking advantage of the project taking out water from Yellow River irrigation, and planted herbage to develop animal husbandry. The fertilizer produced by animal husbandry, can be used to increase fruit yield directly. Thus the positive cycle of agricultural production came into being. Haw tree has ability to harness ditch and slope the fruit tree seedling dig out every two rows, can be planted along slope upward to increase harness altitude of ditch and slope to enlarge land utilization area year after year. Therefore, positive land utilization is based on maintaining and reconstructing the ecologic balance. This land utilization form, depending on scientific plan, management and policy to prevent from soil erosion and increase land productivity, is especially important in western arid region. The main point in this utilization form is to plan comprehensively, exploiting and harness synchronically, do well reserving work for preventing from erosion and disastrous results when people get economic benefit.

Table 4 The erosion rate under different vegetations in ziwu mountain range, Gansu

Land utilization	Sampling depth	Erosion rate percentage
Cultivated land	0—20	53.3
	0—17	48.5
	17—32	52.0
Woodland	4—9	36.0
	19—31	38.3
Irrigated woodland	0—9	25.6
	9—19	22.0
Grassland	0—13	33.8
	13—26	34.4

References

- [1] Songguiqin. The Position of Land Utilization in Water and Soil Conservation. Bulletin of Soil and Water Conservation. 1997.5 the second cover.
- [2] Chen Quangong, Xuzongbao. The Exploitation of Land Utilization Changing in Xifeng Urban, Gansu Science Journal. 1992.3.
- [3] Yongwanzhi, Yucunzu, etc. Harnessing and Evaluating of Loess Plateau Science Publisher, 1992.
- [4] DengHongdi, Dongzaji. Preliminary Research on Exploiting and Utilizing Land Resources in Developing the West of China. Chinese Land Science 2001,1(15):39-42.
- [5] Luohuiqin, etc. Land Resources in Gansu. Gansu Science Publisher 2000.
- [6] Shenyuancun. The Research on Structure and Function of Land Resources. Geography Journal, 1992.6.
- [7] Muguangrong, Luxiaoping. The Balance Form and Continence of Land of Utilization Resources . Chinese Land Science, 1997,11(6):33-35.
- [8] Land Resources in Loess Plateau Chinese Science and Techonlogy Publisher, 1990.
- [9] Xinshushi ,Jangrelin. Chinese Water and Soil Conservation Introduction Agricultural Publisher, 1982.
- [10] Wanggenxu, chengguodang. Soil Resources Characteristic and Continue Developing in Northwest Region., The Soil Science Advance, 1999,5.
- [11] Changqinrui. The Benefit Research of Recovering Vegetation to Prevent from Land Degeneration in Loess Plateau Soil Erosion and Water and Soil Conservation Journal, 1999,4(5):6-9.