

Rural Landscape Types and Recreational Value Spatial Analysis of Valley Area of Loess Plateau: A Case of Hulu Watershed, Gansu Province, China

DONG Suocheng¹, CHENG Hao^{1,2}, LI Yu¹, LI Fujia¹, WANG Zhe^{1,2}, CHEN Feng^{1,2}

(1. Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing 100101, China; 2. University of Chinese Academy of Sciences, Beijing 100049, China)

Abstract: Rural landscape is a complex of natural landscape and human landscape, with various values. The recreational value of rural landscape is a kind of comprehensive benefit with economic, social and ecological, which is provided by the rural landscape as a recreational resource. Loess Plateau is located at the junction of northern and northwestern of China, with serious water and soil erosion and fragile ecological environment. Jingning County is the national poor county, belonging to Liupanshan concentrated poverty areas. Hulu Watershed in Jingning is the typical valley area of Loess Plateau. In the past few decades, Jingning facing the fragile ecology and poverty, has been focusing on apple industry, forming unique rural landscape, exploring an ecological development path, and making much progress in green industrialization and urbanization. The author, according to the apple tree's growing stages, divided the rural landscape of Hulu Watershed into 15 types and analyzed its spatial patterns. The recreational value of Hulu Watershed was evaluated at 1.8×10^8 – 3.6×10^8 yuan (RMB) in 2014, by Travel Cost Method and Contingent Valuation Method. The territorial differentional features of recreational value were that the higher value landscape types concentrated in the surrounding areas of towns and central villages, and the areas along the traffic and river had more development potentiality. The main influence factors were the construction of rural landscape and the development of recreation industry. And the development paths of different landscape types were also proposed. The research conclusions can provide reference for the landscape exploration and recreation industry development in the similar under-developed areas in the valley area of Loess Plateau with fragile ecology and poverty.

Keywords: rural landscape; recreational value; Hulu Watershed; Jingning County; Loess Plateau

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1 Introduction

Landscape is composed of heterogeneous geographical units with different types ecosystems and repetitive patterns (Forman and Godron, 1986). Rural landscape is a complex of natural landscape and human landscape, with economic, social and ecological values (Li *et al.*, 2012), and production, living and ecological functions (Jin *et al.*, 1990; Xie and Liu, 2003; Wang, 2003). The

recreational value of landscape refers to comprehensive benefits integrating economical, ecological and social benefits together, provided by landscape as recreational resources (Pearce and Moran, 2001). The evaluation of the recreational value is the monetary accounting of the comprehensive benefits from an economic point view (Rodelio, 2007). It is an expression of people's willingness to pay, which reflects the comprehensive evaluation of leisure experience, ecological environment, sensory

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Corresponding author: CHENG Hao. E-mail: chenghao0011@163.com

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enjoyment and spiritual harvest (Wu and Dong, 2001). The research evaluated the recreational value of landscape, changed the recreational resources into assets, and proposed the development paths. It will extend the industrial chain, enrich the connotation of industry value, optimize the regional industrial structure, and promote the process of regional industrialization and urbanization (Li, 2008; Li and Tan, 2011).

Foreign researches on rural landscape began in the 1950s and concentrated in rural landscape change (Hannes *et al.*, 1998; Sylvain and Gerald, 2001), rural landscape protection (Peter and James, 1997; Ammon, 2004), rural landscape planning (Edward, 1994; Brandth, 1995) and so on. In China, rural landscape research started later, mainly concentrated in the rural landscape concept and classification (Xiao and Zhong, 1998; Li *et al.*, 2005), temporal and spatial changes of rural landscape pattern and driving mechanism (Wang, 1998; Zhou *et al.*, 1999), rural landscape ecological regionalization (Wang and Liu, 2003; Xie *et al.*, 2003) and so on.

At present, the researches of recreational value mainly focused on the National Park (Jan *et al.*, 2016), National Forest Park (Lei *et al.*, 2015), National Botanical Garden (Norian *et al.*, 2015), urban green space (Andrej *et al.*, 2015), coast beaches (Fan *et al.*, 2015), island (Jarkko *et al.*, 2016) and so on. But the studies of the recreational value of rural landscape, especially evaluating the value, have achieved less. Boris evaluated the contribution degree of landscape characteristics in the recreational value of agricultural landscape through the comparative method (Boris *et al.*, 2016). Lena discussed the effects of seasonal changes on the recreational value of fishing activities (Lena *et al.*, 2015). In China, there were only some studies on recreational value of urban agriculture park and the ancient village (Niu *et al.*, 2005; Zhang, 2006). And the studies only focused on the value evaluation, did not carried out the spatial analysis, which can not guide the development of landscape.

Loess Plateau is located at the junction of northern and northwestern of China, with serious water and soil erosion and fragile ecological environment. Jingning County is the national poor county, belonging to Liupanshan concentrated poverty areas. Hulu Watershed in Jingning is the typical valley area of Loess Plateau. In the past few decades, Jingning facing the fragile ecology

and poverty, has been focusing on apple industry, forming unique rural landscape, exploring an ecological development path, and making much progress in green industrialization and urbanization. Through studying on the rural landscape of Hulu Watershed in micro-scale, according to the apple growth cycle, the author divided the landscape types, evaluated the recreational value, revealed the highest value regions and the mechanism, and proposed the development paths. The research achievements can provide reference for the study of landscape and recreational value in the similar rural areas in the valley area of Loess Plateau with fragile ecology and poverty, especially with a single economic fruit industry as the leading industry.

2 Materials and Methods

2.1 Study area

Jingning County is located at the east of Pingliang City, Gansu Province, China (Fig. 1), which is the typical area in hilly and gully region of Loess Plateau. In 2014, the total population was 4.9128×10^5 yuan (RMB), the urbanization rate was 12.24%, the GDP was 3.7×10^9 yuan (RMB), and the total retail sales of social consumer goods was 2.1×10^9 yuan (RMB). Jingning County is one of the areas where the tourism developed rapidly in Pingliang City. In 2014, the amount of tourists was 8.56×10^5 yuan (RMB), the tourism comprehensive income was 4.1×10^8 yuan (RMB), and the output value of tourism industry accounted for 11.2% of GDP.

Hulu River, called 'Long Water', was one affluent of Weihe River. Hulu Watershed formed the typical valley landscape of Loess Plateau. The study areas is a part of Hulu Watershed in the middle of Jingning County, covered an area of 148.42 km², crossing 27 administrative villages, with about 50 123 persons living there. This area highlights the more unique rural landscape effects due to the advantages of apple industry and rural settlements.

2.2 Research methods

Based on the perspective of economics, recreational value can be divided into use value and non-use value (Fig. 2). The use value refers to the tourists gain benefits directly or indirectly in the process of recreation. It is the value that the recreation object can bring to the recreation subject, and could be divided into direct use

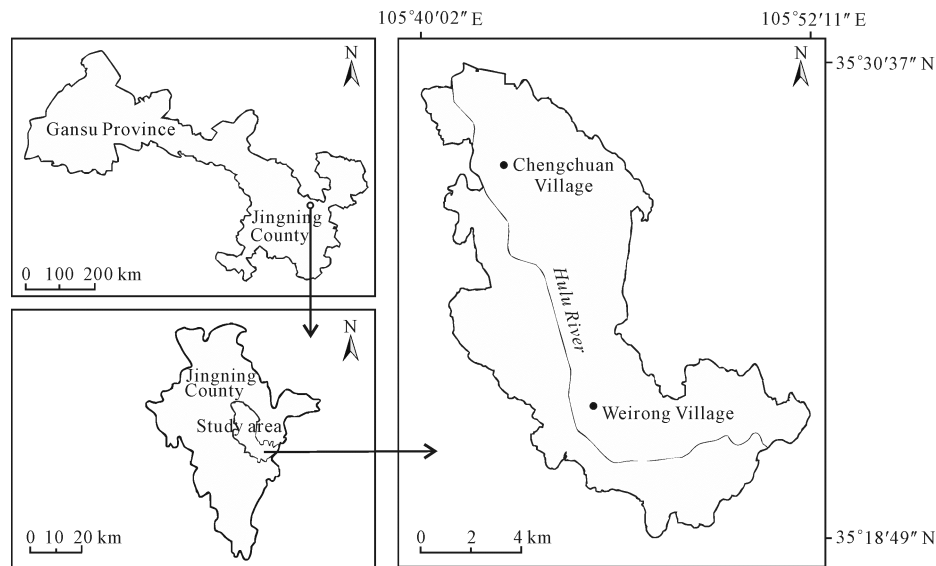


Fig. 1 Location of study area

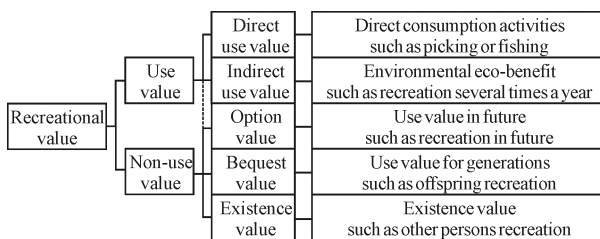


Fig. 2 Constitution system of recreational value

value (direct cost in one time) and indirect use value (cost in several times one year). Non-use value refers to the hidden value that is not used at present, but in the future. It is the intrinsic attribute that belongs to the resource itself, and could be divided into the option value (the use value in future), the bequest value (the use value for generation) and existence value ((the use value for others)).

The methods of recreational value accounting are Hedonic Priced Method (HPM), Expenditure Method (EM), Benefit Transfer Method (BTM), Travel Cost Method (TCM) and Contingent Valuation Method (CVM). This study used the TCM method to accounting the use value, used the CVM method to accounting the non-use value, and then obtained the total recreational value.

2.2.1 Use value

(1) The Direct Use Value

Travel Cost Method (TCM) was used for accounting the direct use value. The direct use value can be expressed as follows:

$$C_{DUV} = C_1 + C_2 + C_3 \quad (1)$$

where C_{DUV} expresses direct use value, C_1 is tourists' transportation fee; C_2 is all the tourists' expenses (including eating, sightseeing, fishing, purchasing and so on); C_3 is temporal opportunity cost.

The temporal opportunity cost refers to the cost of a person who is engaged in one event but not another event. It can be expressed as follows:

$$C_3 = 40\% \times (T_1 + 2T_2) \times (I_3 / 21 \times 8) \quad (2)$$

where T_1 is time of tourists spent in Hulu Watershed; T_2 is time of tourists spent on arriving at Hulu Watershed; I_3 is tourists' monthly income.

(2) The Indirect Use Value

According to TCM method, the indirect use value can be expressed as follows:

$$C_{IUV} = \frac{\sum C_i N_i}{n} \quad (3)$$

where C_{IUV} expresses indirect use value, C_i is total cost of tourist i ; N_i is the times of tourist i visit Hulu Watershed per year; n is the number of tourists in investigation.

2.2.2 Non-use value

Non-use value is the value given by people who know the resource existence. Contingent Valuation Method (CVM) is used for accounting the non-use value. The non-use value can be expressed as follows:

$$E(WTP) = \sum P_i B_i \quad (4)$$

where E expresses Non-use Value, P_i is the proportion of WTP (willingness to pay); B_i is the WTP of tourist i .

2.3 Data sources

To analyze the rural landscape, we chose the high resolution remote sensing data collected by ZY-3 satellite provided by Earth Observation and Digital earth, CAS. The geodetic coordinates were 35°30'37"N, 105°40'02"E and 35°18'49"N, 105°52'11"E. The data acquisition time was July 25, 2014, and the spatial resolution was 2.1 m × 2.1 m.

To deeply understand the development situation of Hulu Watershed recreation industry, the survey questionnaires were issued on July 3-10, 2015 at the areas along the Hulu River. The purpose was to find out the contents of recreational activities, the recreational cost, the environmental comments and so on. There were 200 copies of survey questionnaires issued in total, and the recovery rate was 100%, the effective rate was 98%.

3 Results

3.1 Classification and spatial patterns of rural landscape

3.1.1 Classification of rural landscape

According to previous studies (Liu, 1996; Zhang and

Bo, 2000), using the traditional land utilization and cover classification of China, referencing ecological land classification method, the rural landscape in Hulu Watershed was divided into six primary types (Table 1).

Hulu Watershed is dominated by apple industry, the layout and the growth cycle of apple trees are the key influencing factors of rural landscape. The apple tree growth will go through four periods. Firstly, young period is the time from apple trees engraftment to first flowering, when the trees have no ornamental value, but research value due to the different grafting technology and management measures. Secondly, ripe period is the time from the apple trees beginning to ripe to achieving stable yield, when the trees grow strong, blossom exuberant and have a higher ornamental value. Thirdly, post-ripe period is the time with high, stable and superior production, when the trees have a higher economic value and could be picked well. Fourthly, the old period is the time of apple trees production reduced, when the tress should be updated, and be grown again three years later. According to apple's growth cycle and study purposes, the rural landscape was divided into 15 sub-types.

3.1.2 Spatial patterns of rural landscapes

Hulu River passed across the study area from north to south, and separated the study area into west and east parts. From the river to two sides, the elevation gradually increased, and the landscape types changed from water landscape to cultivated landscape, then to forest landscape,

Table 1 Classification system of rural landscape

Primary type		Sub-type		Meaning
Number	Type	Number	Type	
1	Cultivated landscape	1.1	Dry land landscape	Refers to the cultivated land with natural rainfall or irrigation facilities; vegetable plot; rotation plot
		1.2	Agriculture facility landscape	Refers to building rooms for agriculture such as solar greenhouse, and others constructed on purpose to improve the crop yield
		2.1	Young apple trees landscape	Refers to the apple forest in the young period
		2.2	Ripe apple trees landscape	Refers to the apple forest in the ripe period
2	Forest landscape	2.3	Post-ripe apple trees landscape	Refers to the apple forest in the post-ripe period
		2.4	Park landscape	Refers to the land managed and operated by professional enterprise, circulated from peasant households, generated higher additional landscape value
		2.5	Other forest landscape	Refers to other natural forest and man-made forest
3	Grassland landscape	3.1	Pastureland landscape	Refers to grassland planting forage grass such as alfalfa
		3.2	Other grassland landscape	Refers to natural grassland growing herbaceous plants
4	Water landscape	4.1	Pond landscape	Refers to river and water naturally formed or artificial exploited
		4.2	Bottomland landscape	Refers to land between water level in normal period and flood period of river and lake
5	Construction landscape	5.1	Rural residential landscape	Refers to the land for residents living
		5.2	Culture landscape	Refer to the land built characteristic or cultural architecture, dwelling and so on
		5.3	Industry landscape	Refers to land for industrial production and processing
6	Unused Landscape	6.1	Wasteland landscape	Refers to land not used yet

then to forest landscape (Fig. 3).

The rural landscape of Hulu Watershed was dominated by forest land, covering an area of 54.89%. While the forest land was dominated by apple trees landscape which covered 60.18% of forest land (Table 2). The landscape patterns of Hulu Watershed is taking the forest landscape as the basement, the Hulu River as the corridor, and cultivated landscape, grassland landscape, construction landscape and the other landscapes as the patches. It is basically formed the apple industry intensive belt along the Hulu River, the rural settlement intensive belt along the traffic road, and the mountain ecological conservation belt on both sides of the mountains.

Hulu Watershed was the core area of rural recreational areas in Jingning County, and had formed 12 recreational parks, such as Daditan leisure agriculture park, Baojiazuitou wetland park and so on, covering 7 landscape sub-types (Fig. 4).

3.2 Evaluation and spatial analysis of recreational value

3.2.1 Evaluation of recreational value

According to the questionnaires, using the Equation (1)

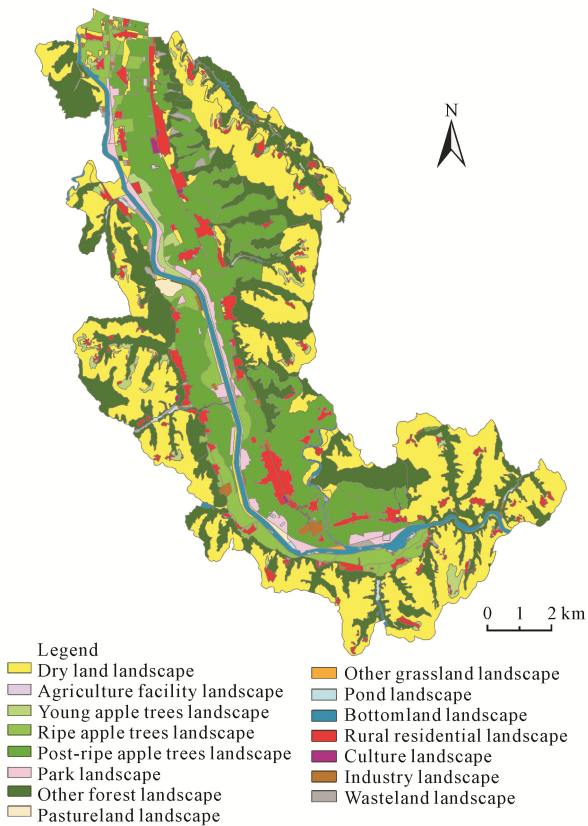


Fig. 3 Spatial patterns of landscapes in Hulu Watershed

Table 2 Areas of landscape patches in Hulu Watershed

Number	Type	Area of patch (ha)	Percentage of total area (%)	Percentage of primary type area (%)
1	Cultivated landscape	4959.5105	33.41	100.00
1.1	Dry land landscape	4945.6136		99.72
1.2	Agriculture facility landscape	13.8969	—	0.28
2	Forest landscape	8147.2071	54.89	100.0
2.1	Young apple trees landscape	366.4077	—	4.50
2.2	Ripe apple trees landscape	900.7393	—	11.06
2.3	Post-ripe apple trees landscape	3228.8210	—	39.63
2.4	Park landscape	406.6312	—	4.99
2.5	Other forest Landscape	3244.6079	—	39.82
3	Grassland landscape	95.5016	0.64	100.0
3.1	Pastureland landscape	88.1533	—	92.31
3.2	Other grassland landscape	7.3483	—	7.69
4	Water landscape	553.3526	3.73	100.0
4.1	Pond landscape	48.6657	—	8.79
4.2	Bottomland landscape	504.6869	—	91.21
5	Construction landscape	963.9844	6.49	100.0
5.1	Rural residential landscape	845.5731	—	87.72
5.2	Culture Landscape	9.6398	—	1.00
5.3	Industry Landscape	108.7715	—	11.28
6	Unused Landscape	122.8980	0.83	100.0
6.1	Wasteland landscape	122.8980	—	
Total area of landscape patches		14842.4542	100.00	—

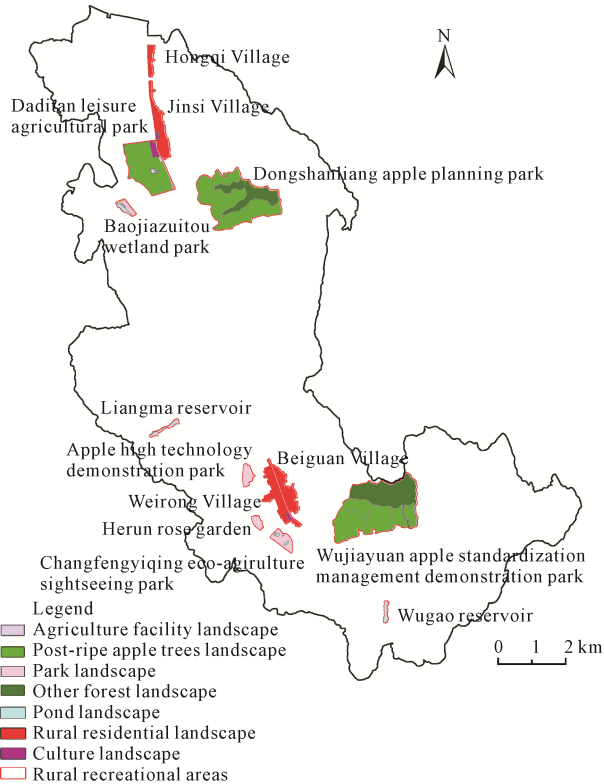


Fig. 4 Spatial patterns of recreational landscapes in Hulu Watershed

and Equation (2), the direct use value was 145–418 yuan (RMB) per person in 2014. In the same way, using Equation (3), the indirect use value was 225–702.5 yuan (RMB) per person in 2014. And using Equation (4), the non-use value was 392.85 yuan (RMB) per person in 2014.

Referring to the development of the agricultural parks in China, we inferred that there are 12 recreational areas in Hulu Watershed, and the number of tourists was 2×10^4 on average in 2014. So, in 2014, the use value of Hulu Watershed was 0.89×10^8 – 2.69×10^8 yuan (RMB), the direct use value was 0.25×10^8 – 1.00×10^8 yuan (RMB), and the indirect use value was 0.54×10^8 – 1.69×10^8 yuan (RMB). The option value was 0.30×10^8 yuan (RMB), accounted for 32.14%, the bequest value was 0.37×10^8 yuan (RMB), accounted for 39.29%, and the existence value was 0.27×10^8 yuan (RMB), accounted for 28.57%.

In summary, the recreational value of Hulu Watershed is 1.80×10^8 – 3.6×10^8 yuan (RMB) in 2014.

3.2.2 Spatial analysis of recreational value

(1) Spatial analysis of use value

The use value space analysis is a complicated system

engineering. The relationship between landscape and use value is established by setting the landscape and use value as two sub-systems.

According to the questionnaires, the tourists' recreational activities in Hulu Watershed were 10 types, such as picking, shopping and so on, and the use value of each type recreational activity is displayed in the Table 3.

Different type recreational activity selected different landscape space and provided different use value. The relationship between landscape and use value should be established as shown in Fig. 5, which included 7 parts.

- 1) The post-ripe apple trees landscape is formed with the apple forest in the post-ripe period, when the production of apples is high, stable and superior, and the apples are big and colorful. The picking activity is suitable and creates use value.
- 2) Agriculture facility landscape refers to building rooms for agriculture such as solar greenhouse, in which characteristics crops are planted, such as tropical fruit, anti-season vegetables and so on. The picking activity is suitable throughout the year and creates use value.
- 3) Other forest landscape refers to natural forest and man-made forest, and distributes on both sides of mountains. For the beautiful scenery, it attracts many tourists to sightseeing, hiking, photographing, and creates use value.
- 4) Park landscape is the land operated and managed by enterprise. Different enterprises organize different agricultural activities to attract tourists to experiencing and photographing, and create use value.
- 5) Cultural landscape refers to the region has characteristic architectures, temples and so on, which attracts tourists to experience the rural culture and create use

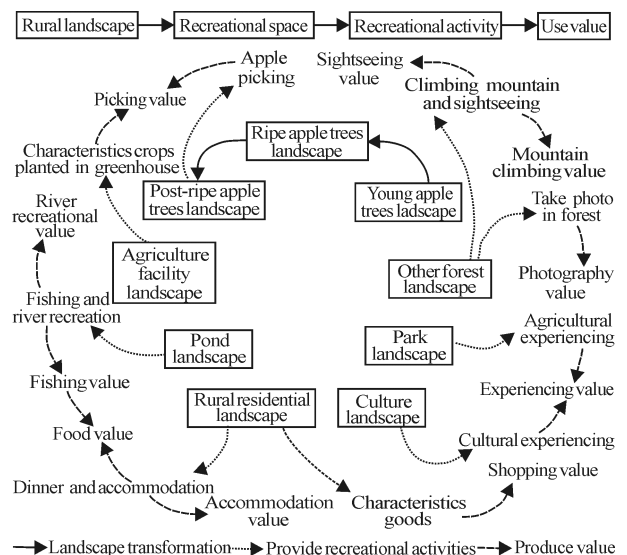


Fig. 5 Relationship between landscape and use value

value. 6) The rural residential landscape refers to the areas for residents living. The accommodation, shopping and dining are suitable there and create use value. 7) The ponds landscape refers to rivers or water naturally formed or artificial exploited, which attracts tour-

ists to recreating, fishing, cooking nearby, and creates use value.

According to relationship between landscape and use value, we could obtain the distribution of use value in Hulu Watershed (Table 3).

Table 3 Distribution of use value in Hulu Watershed

No.	Recreational activity	Activity use value (10 ⁴ yuan (RMB)) (Selection Ratio)	Recreational space	Landscape type	Space use value (10 ⁴ yuan (RMB)) (Selection Ratio)	Area of patch (ha)	Unit use value (10 ⁴ yuan (RMB)/ha)
1	Sightseeing	1457–4414 (16.14%)	Dongshanliang apple planting park, Wujiayuan apple standardization management demonstration park	25 Other forest landscape	1457–4414 (100%)	233.68	6.23–18.89
			Baojiazuitou wetland park, Changfengyiqing eco-agriculture sightseeing park	24 Park landscape	132–400 (30%)	31.30	4.23–12.79
			Apple seeding park, Apple high technology demonstration park	24 Park landscape	66–200 (15%)	21.62	3.06–9.26
2	Experiencing	441–1334 (4.96%)	Daditan leisure agriculture park, Herun rose garden	24 Park landscape	154–467 (35%)	11.04	13.98–42.30
			Daditan leisure agriculture park	53 Culture landscape	35–107 (8%)	9.96	3.54–10.72
			Jinsi village, Weirong village	53 Culture landscape	53–160 (12%)	5.15	10.28–31.10
			Daditan leisure agriculture park	12 Agriculture facility landscape	86–262 (15%)	4.41	19.57–59.29
3	Picking	576–174 (6.49%)	Daditan leisure agriculture park	11 Post-ripe apple trees landscape	202–611 (35%)	129.45	1.56–4.72
			Dongshanliang apple planting park, Wujiayuan apple standardization management demonstration park	11 Post-ripe apple trees landscape	288–873 (50%)	447.72	0.64–1.95
4	Shopping	1745–5285 (19.66%)	Hongqi village, Jinsi village, Beiguan village, Weirong village	51 Rural residential landscape	1745–5285 (100%)	177.92	9.81–29.70
			Baojiazuitou wetland park, Changfengyiqing eco-agriculture sightseeing park	41 Pond landscape	214–647 (15%)	8.11	26.33–79.91
5	Food	1424–4311 (16.03%)	Hongqi village, Jinsi village, Beiguan village, Weirong village	51 Rural residential landscape	1210–3664 (85%)	177.92	6.80–20.60
6	Accommodation	610–1848 (6.87%)	Jinsi village, Beiguan village, Weirong village	51 Rural residential landscape	614–1860 (100%)	161.36	3.78–11.45
7	Mountain climbing	1051–3182 (11.82%)	Dongshanliang apple planting park, Wujiayuan apple standardization management demonstration park	25 Other forest landscape	1051–3182 (100%)	233.68	4.50–13.62
			Baojiazuitou wetland park, Changfengyiqing eco-agriculture sightseeing park	24 Park landscape	171–517 (28%)	31.30	5.46–16.53
			Apple seeding park, Apple high technology demonstration park	24 Park landscape	85–259 (14%)	21.62	3.95–11.97
8	Photography	610–1848 (6.87%)	Daditan leisure agriculture park, Herun rose garden	24 Park landscape	220–665 (36%)	11.04	19.90–60.28
			Dongshanliang apple planting park, Wujiayuan apple standardization management demonstration park	25 Other forest landscape	134–407 (22%)	233.68	0.57–1.74
9	Fishing	576–1745 (6.49%)	Baojiazuitou wetland park, Changfengyiqing eco-agriculture sightseeing park	41 Pond landscape	409–1239 (71%)	8.11	50.41–152.72
			Liangma reservoir, Wuma reservoir.	41 Pond landscape	167–506 (29%)	15.66	10.67–32.31
10	Water tion	399–1181 (4.39%)	Baojiazuitou wetland park, Changfengyiqing eco-agriculture sightseeing park	41 Pond landscape	273–826 (70%)	8.11	33.65–101.82
			Liangma reservoir, Wuma reservoir.	41 Pond landscape	117–354 (30%)	15.66	7.47–22.60
Total					8880–26892 (100%)		

(2) Spatial analysis of non-use value

The non-use value space analysis is also complicated system engineering. The relationship between landscape and non-use value is established by setting the landscape and non-use value as two sub-systems.

According to the questionnaires, the factors that affect the willingness to pay of tourists in Hulu Watershed were 10 types, such as transportation, accommodation and so on. The WTP of each factor is displayed in the Table 4.

Different influence factor was belongs to different landscape. The relationship between landscape and non-use value should be established as shown in the Fig. 6, which included 4 parts: 1) The traffic condition affects the accessibility of recreational place. The main traffic routes of the study area are Jingzhuang Road and Binhe Road. So the regions between the two roads own the better traffic condition and have the corresponding non-use value. 2) Dining, shopping and accommodation conditions refer to the

Table 4 Distribution of non-use value in Hulu Watershed

No.	Non-use Value	Use Value (10 ⁴ yuan (RMB))	Environmental factors (Selection ratio)	Landscape type (Selection ratio)	Area of patch (ha)	Unit non-use value (10 ⁴ yuan (RMB)/ha)
1	Option Value	496	1 Traffic Condition (16.36%)	Post-ripe apple trees landscape and so on (100%)	2855.97	0.17
		276	2 Accommodation (9.09%)	Rural residential landscape (100%)	845.57	0.33
		496	3 Dining Condition(16.36%)	Rural residential landscape (85%)	845.57	0.50
				Pond landscape (15%)	48.67	1.53
		661	4 Sanitary Condition (21.82%)	Post-ripe apple trees landscape and so on (100%)	1096.04	0.60
		110	5 Recreational Facility (3.64%)	Post-ripe apple trees landscape and so on (100%)	1096.04	0.10
		276	6 Shopping Condition (9.09%)	Rural residential landscape (100%)	845.57	0.33
		165	7 Recreational Projects (5.45%)	Post-ripe apple trees landscape and so on (100%)	1096.04	0.15
		165	8 Recreational Space (5.45%)	Post-ripe apple trees landscape and so on (100%)	1096.04	0.15
		220	9 Natural Scenery (7.27%)	Cultivated landscape and so on (100%)	13866.40	0.02
2	Bequest Value	165	10 Human Scenery (5.45%)	Construction landscape (100%)	976.05	0.17
		289	1 Traffic Condition (7.81%)	Post-ripe apple trees landscape and so on(100%)	2855.97	0.10
		347	2 Accommodation (9.38%)	Rural residential landscape (100%)	845.57	0.33
		405	3 Dining Condition (10.94%)	Rural residential landscape (85%)	845.57	0.50
				Pond landscape(15%)	48.67	1.53
		810	4 Sanitary Condition (21.88%)	Post-ripe apple trees landscape and so on (100%)	1096.04	0.74
		289	5 Recreational Facility (7.81%)	Post-ripe apple trees landscape and so on (100%)	1096.04	0.26
		174	6 Shopping Condition (4.69%)	Rural residential landscape (100%)	845.57	0.21
		232	7 Recreational Projects (6.25%)	Post-ripe apple trees landscape and so on (100%)	1096.04	0.21
		347	8 Recreational Space (9.38%)	Post-ripe apple trees landscape and so on (100%)	1096.04	0.32
3	Existence Value	579	9 Natural Scenery (15.63%)	Cultivated landscape and so on (100%)	13866.40	0.04
		232	10 Human Scenery (6.25%)	Construction landscape (100%)	976.05	0.24
		207	1 Traffic Condition (7.69%)	Post-ripe apple trees landscape and so on (100%)	2855.97	0.07
		207	2 Accommodation (7.69%)	Rural residential landscape (100%)	845.57	0.98
		311	3 Dining Condition (11.54%)	Rural residential landscape (85%)	845.57	1.22
				Pond landscape(15%)	48.67	3.74
		414	4 Sanitary Condition (15.38%)	Post-ripe apple trees landscape and so on (100%)	1096.04	0.38
		259	5 Recreational Facility (9.62%)	Post-ripe apple trees landscape and so on (100%)	1096.04	0.60
		207	6 Shopping Condition (7.69%)	Rural residential landscape (100%)	845.57	0.78
		156	7 Recreational Projects (5.77%)	Post-ripe apple trees landscape and so on (100%)	1096.04	0.50
		259	8 Recreational Space (9.62%)	Post-ripe apple trees landscape and so on (100%)	1096.04	0.70
		518	9 Natural Scenery (19.23%)	Cultivated landscape and so on (100%)	13866.40	0.09
		156	10 Human Scenery (5.77%)	Construction landscape (100%)	976.05	0.57

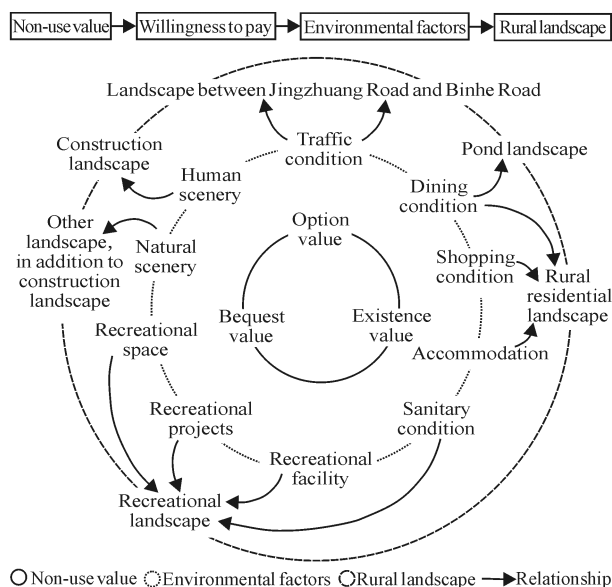


Fig. 6 Relationship between landscape and non-use Value

regions carried out related activities, which have the corresponding non-use value. 3) Recreational space, recreational facility and sanitary conditions refer to the regions carried out recreational activities, which have the corresponding non-use value. 4) The scenery of the study area is composed of human scenery and natural scenery. The human scenery is formed with rural residential landscape, culture landscape and industry landscape, which are influenced strongly by human activities and have the corresponding non-use value. The natural scenery is formed with other landscapes having the corresponding non-use value, in addition to construction landscape.

According to relationship between landscape and non-use value, we could obtain the distribution of non-use value in Hulu Watershed (Table 4).

(3) Spatial analysis of recreational value

Based on the space analysis of the use value and non-use value, using the ArcGIS software, the rural landscape of Hulu Watershed were assigned by recreational value, which is added by the intermediate value of use value and the whole value of non-use value (Fig. 7). The territorial differentiatinal features of recreational value was that the high recreational value areas were concentrated in the 12 parks and 7 landscape sub-types. The areas surrounding the town and center village formed the high recreational value areas, the areas on both sides of the mountain formed the low recreational value areas, the areas along the road and river had the high recreational value potential, and the areas surrounding the villages on the mountain were also the potential areas.

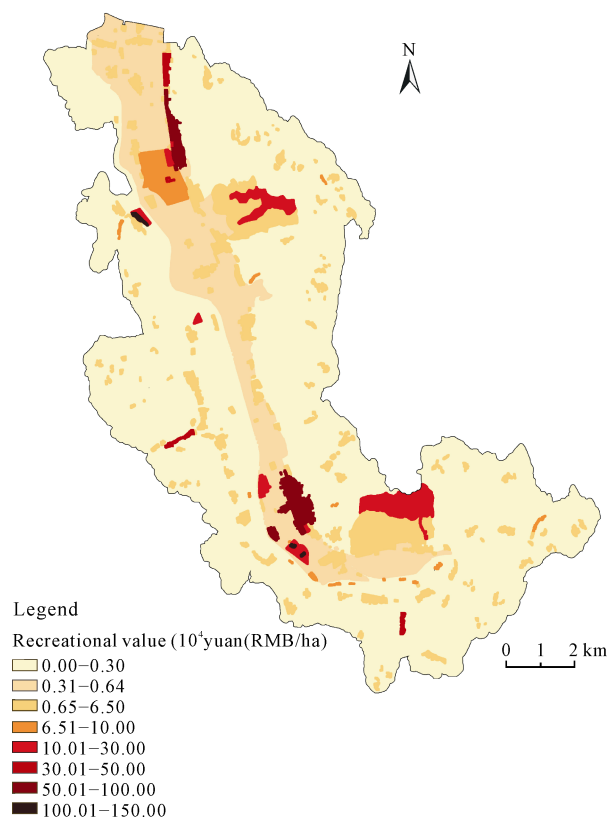


Fig. 7 Territorial differentiatinal features of recreational value in Hulu Watershed

4 Discussion

4.1 Value distribution mechanism

According to the territorial differentiatinal features of recreational value in Hulu Watershed, it can be seen that the main factors influencing the spatial differentiation were the rural landscape construction and the recreation industry development.

The high recreational value areas were mainly distributed in the areas surrounding the town and center village. The formation mechanism is as follows. Firstly, the high value areas located at the areas between Jingan Road and Linjiang Road, where the transportation condition was convenient. The recreational service facilities developed well, and could meet the basic needs of tourists, which promoted the development of recreational activities, and formed recreational value. Secondly, the high recreational value areas were concentrated in the post-ripe apple trees landscape, agriculture facility landscape and so on. The industrial base was well, which was appropriate to carry out rural recreational activities with apple as the main content. For the characteristic of agricultural facilities was not affected by seasons, it was appropriate to carry out tourism

on every season, and achieved recreational value.

The low recreational value areas were mainly distributed in the areas on both sides of the mountain. The formation mechanism is as follows. Firstly, the traffic infrastructure construction was weak. There were even no public roads on both sides of the mountain. Although the local villagers got rid of poverty, the living conditions still need to improve. The lacks of service facilities, and the weak of traffic conditions, were unable to meet the basic requirements of recreational activities.

4.2 Landscape development mode

According to the territorial differentiatial features of recreational value in Hulu Watershed, we got the value distribution mechanism. The result showed that the development of recreation function is not complete and the utilization of recreational value is not sufficient. Different landscape types could provide different recreational activity spaces and organize different recreation projects, which would produce different recreational value. As a result, the exploitation of landscape should adopt diversified development models, and the optimization and development priorities should be put forward for different types of rural landscape.

The development priorities of apple trees landscape are as follows. Firstly, it should promote the mountain apple industry, increase the apple planting areas, improve the quantity and quality of fruits, and ensure the stability of apple industry development. Secondly, the idea of the whole life cycle of apple should be used in recreation development, and the recreational function of the whole life cycle of apple should be excavated. It could plant flowers under forest and increase the sightseeing value in the young period. It could apply techniques to promote flowering and increase the sightseeing value in the ripe period. It could carry out apple picking and increase the picking value in the post-ripe period. In the old period, the planting site could be used as multifunctional recreational area, carry out experiencing activities and increase the experiencing value.

The development priorities of rural residential landscape are as follows. Firstly, the types and the number of recreational services should be increased. At present, there were accommodation, shopping and diner supplied in the rural residential landscape, but the performance was primary, such as hotel, markets. We need more diverse recreational services forms, such as ecological restaurant, farmhouse, and touring car, rent and so on. We could also establish information service platform on line, to rich the way of

shopping. Secondly, we should drive more farmers to participate in the recreational activities, and expand the range of recreation. At present, the farmers had participated in were mainly in Hongqi Village, Jinsi Village, Beiguan Village, Weirong Village. In future, the farmers participated in recreational activities should be more than 90% in the villages between the between Jingan road and Linjiang road, and should be more the 40% in the villages on the mountain.

The development priorities of agriculture facility landscape are as follows. Firstly, it should improve the speed of agricultural facilities extension, for the characteristic of agricultural facilities was suitable for promoting in the Loess Hilly and gully region of the Loess Plateau, where the ecological environment is fragile and the water and soil erosion is serious. The area of agricultural facilities should be double by 2020, and should be triple by 2025. Secondly, for the characteristic of agricultural facilities was not affected by seasons, it was appropriate to carry out tourism on every season, and achieve more recreational value.

5 Conclusions

Hulu Watershed is the typical valley area located in hilly and gully region of Loess Plateau, with serious water and soil erosion and fragile ecological environment. Firstly based on the high resolution remote sensing data collected by ZY-3 satellite, according to apple trees' growth cycle, the rural landscape of Hulu Watershed was divided into 6 primary types and 15 sub-types. Then through accounting the use value by TCM method and the non-use value by CVM method, we got the recreational value of Hulu Watershed is 1.8×10^8 – 3.6×10^8 yuan (RMB) in 2014. Finally, based on the spatial analysis of the use value and non-use value, the high recreational value areas were concentrated in the 12 parks and 7 landscape sub-types. The areas surrounding the town and center village formed the high recreational value areas, the areas on both sides of the mountain formed the low recreational value areas, the areas along the road and river had the high recreational value potential, and the areas surrounding the villages on the mountain were also the potential areas. The main influence factors of recreational value were the rural landscape construction and the recreation industry development. The exploitation of landscape should adopt diversified development models, and the optimization and development priorities should be put forward for different types of rural landscape.

Through studying on the recreational value of rural

landscape in Hulu Watershed, it will provide reference for the study of landscape and recreational value in the similar rural areas in valley area of Loess Plateau with fragile ecology and poverty, especially the areas with a single economic fruit industry as the leading industry. The survey questionnaires were issued to analyzing the recreational value, and the conclusions conformed to the actual situation. The research method is simple, scientific and suitable for the study area. The research achievement reveals that rural landscape has relative high recreational value, the recreational industry will gradually become a power industry to realize the green development. Based on this, the direction of further research could be the rural landscape optimization, recreational value change simulation, improvement countermeasures establishment and development model innovation, through application of LV-SD model (Landscape and Value System Dynamics Model).

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