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Research Article

Seasonal Variation and Characterization of the Micrometeorology in Linpan Settlements in the Chengdu Plain, China: Microclimatic Effects of Linpan Size and Tree Distribution

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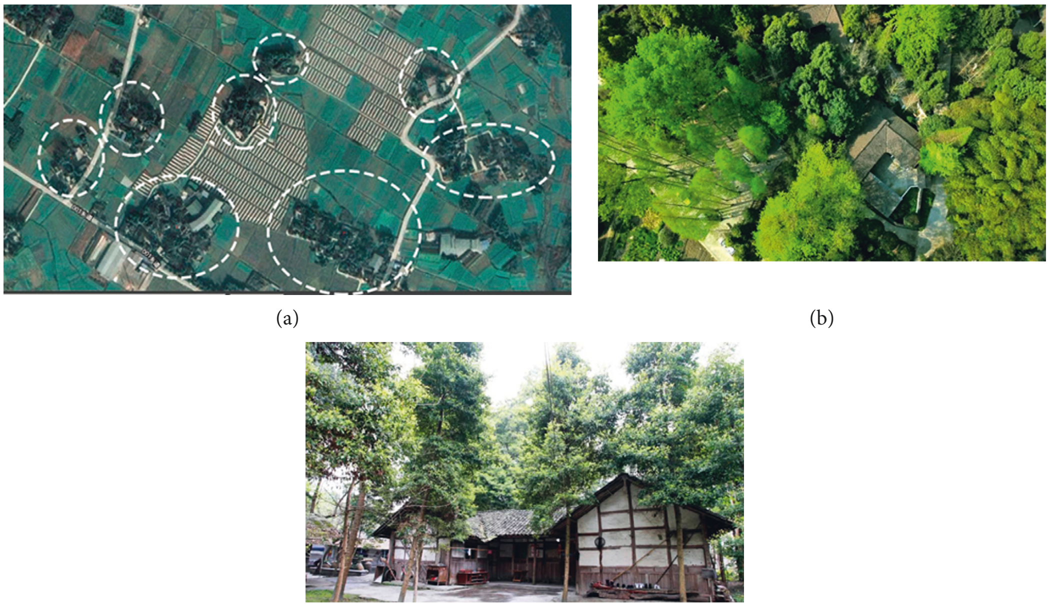
Linpan settlements (abbreviated as Linpan) are the most important traditional type of rural settlement in the Chengdu Plain, and they are an important part of the agroforestry ecological system in southwest China. In this study, we measured the micrometeorological parameters (air temperature, solar radiation, relative humidity, and wind speed) in 12 Linpans for two years to determine the seasonal micrometeorology variations; then, we explored the impacts of Linpan size and tree distribution on the Linpan micrometeorology. The results show that the Linpans undergo seasonal cooling (from 0.6 to 1.3°C), humidification (from 0.9% to 4.1%), reduction in solar radiation flux (from 92.1 to 496.0 W/m^2), and changes in wind speed (by 0.4 to 0.5 m/s) compared to the surrounding environment. Both solar radiation flux and wind speed showed the following decreasing trend with respect to sampling positions in the Linpan: outside > edge > center. The Linpan size did not affect the solar radiation flux or wind speed over the four seasons. The main factor affecting solar radiation flux and wind speed was the horizontal tree distribution not the Linpan size. However, the Linpan size was significantly correlated with the air temperature in summer and winter. Large Linpans ($>5\times10^3$ m^2) showed better ability to control the temperature to within a comfortable range in extremely hot and cold seasons. The Linpan size also showed a negative relationship with the relative humidity, but only in winter. Among the tree distribution patterns, a scattered distribution was optimal to achieve a comfortable micrometeorology over the course of the year. In addition, we suggest some ways to adapt the Linpan micrometeorology, which could be used to protect traditional Linpans, as well as for ecological restoration.

1. Introduction

Linpan settlements (abbreviated as Linpan) are the elementary unit of the villages found in the Chengdu Plain, a beautiful and unique rural landscape in southwest China. Linpan consists of farmers' houses surrounded by a large number of trees, water, and land (Figure 1) and represents an important part of the local agroforestry ecosystem. The tree canopy coverage rates of Linpan are above 60%. Moreover, Chinese traditional farming culture and regional history are maintained by these settlements. In 2011, the number of Linpan in Chengdu Plain was more than 90,000 with a total area of 59,200 ha, and the number of people living in Linpan was 4.5 million, accounting for 77.2% of the total rural population in the Chengdu Plain.

Nevertheless, increasing urban and rural integration in this region is threatening the survival of traditional Linpans, which have changed significantly with respect to quantity and structure [1]. In fact, currently, approximately 800 Linpans disappear per year, and the rate of decrease is accelerating. For example, 11,000 Linpans were recorded in Pi county at 2003, but, in 2009, the total number of Linpans had decreased sharply to fewer than 8,700. In addition, the number of local residents in Linpan has decreased substantially because of increasing migration to new settlements in towns or rural areas. Consequently, the traditional Linpans are becoming deserted. To date, only a few studies have discussed Linpan because it is only since 2007 that the value of the Linpan to the ecology and landscape has been recognized by researchers [2]. Most of these studies have



(a) (b) (c)

Figure 1: Linpan scene in Chengdu Plain.

highlighted Linpan protection [3, 4]. For example, Li et al. [5] suggested improving infrastructure, renovating traditional buildings, and promoting industrial innovation to protect Linpan. Yang et al. [6] discussed the protection of the water systems, roads, and agricultural lands of individual Linpan. In addition, a few research projects have been conducted to investigate the plant community in Linpan [7–9]. A total of 310 plant species belonging to 106 families were found in the sampled Linpan [8]. In contrast, some studies have focused more on the Linpan landscape. For example, the shape of Linpan is becoming simplified [10]. Chen et al. [11] identified Linpan landscape "genes" and summarized the common genes and individual genes, and an assessment system for the Linpan landscape was established using an analytic hierarchy process (AHP) [12].

Crucially, a comfortable micrometeorology is key to many well-loved and well-used outdoor places [13] and is one of the factors influencing the formation of traditional villages [14]. Moreover, the micrometeorology directly and indirectly influences many biological processes and patterns in agroforestry ecosystems, such as plant growth, species distribution, soil development, and water, carbon, and nutrient cycling [15]. Recently, there have been many reports on the micrometeorology of urban green space; most have discussed the roles of plants or greening size in moderating the micrometeorology [16]. For example, it has been found that a combination of higher levels of tree canopy density (LAI 9.7) coupled with "cool" materials (albedo of 0.8) produces the largest urban air temperature reduction [17]. Abreu-Harbich et al. [18] pointed out that there is a highly significant negative linear correlation between the air temperature and canopy cover ratio of the green space, and a study based on 39 parks in Shanghai found that park size is the main factor that influences the cooling effect on land surface temperature [19]. In contrast, Cao et al. [20] reported that a nonlinear relationship existed between park size and the "cool island" intensity, which was mainly affected by the park composition of trees and shrubs. However, these studies have mostly focused on the air temperature in urban areas while ignoring other parameters; moreover, only little attention has been given to micrometeorology variability over the four seasons.

There are no reports about the seasonal micrometeorology of Linpan. Thus, this study has the following goals: (a) to evaluate the ecological value of the traditional Linpan settlements from a new perspective, (b) to quantify seasonal variation of Linpan micrometeorology, (c) to examine the influence of the Linpan size and tree distribution patterns on the micrometeorology over the four seasons, and (d) to give some suggestions of methods to promote a comfortable micrometeorology for the restoration of traditional Linpans and new rural settlements in China.

2. Methods

2.1. Site Background. In total, 12 traditional Linpans located in Sandaoyan town (30°52′14″N, 103°54′49″E), Pi county (30°48′38.46″N, 103°53′14.13″E), Chengdu Plain (30°3N, 104°3′E), China, were chosen for the study. The Linpan ranged in size from 2,000 to 10,000 m^2 (Figures 2(a) and (2b)). In Sandaoyan town, there are more than 600 traditional Linpans. About 79.16% of the rural population live in these Linpans. During the study period, the average daytime temperature was 13°C in spring, 29°C in summer, 21°C in the fall, and 9°C in winter, as reported by the National Meteorological Observatory for Sandaoyan town. The average annual wind speed and relative humidity were 0.7 m/s and 60–70%, respectively.

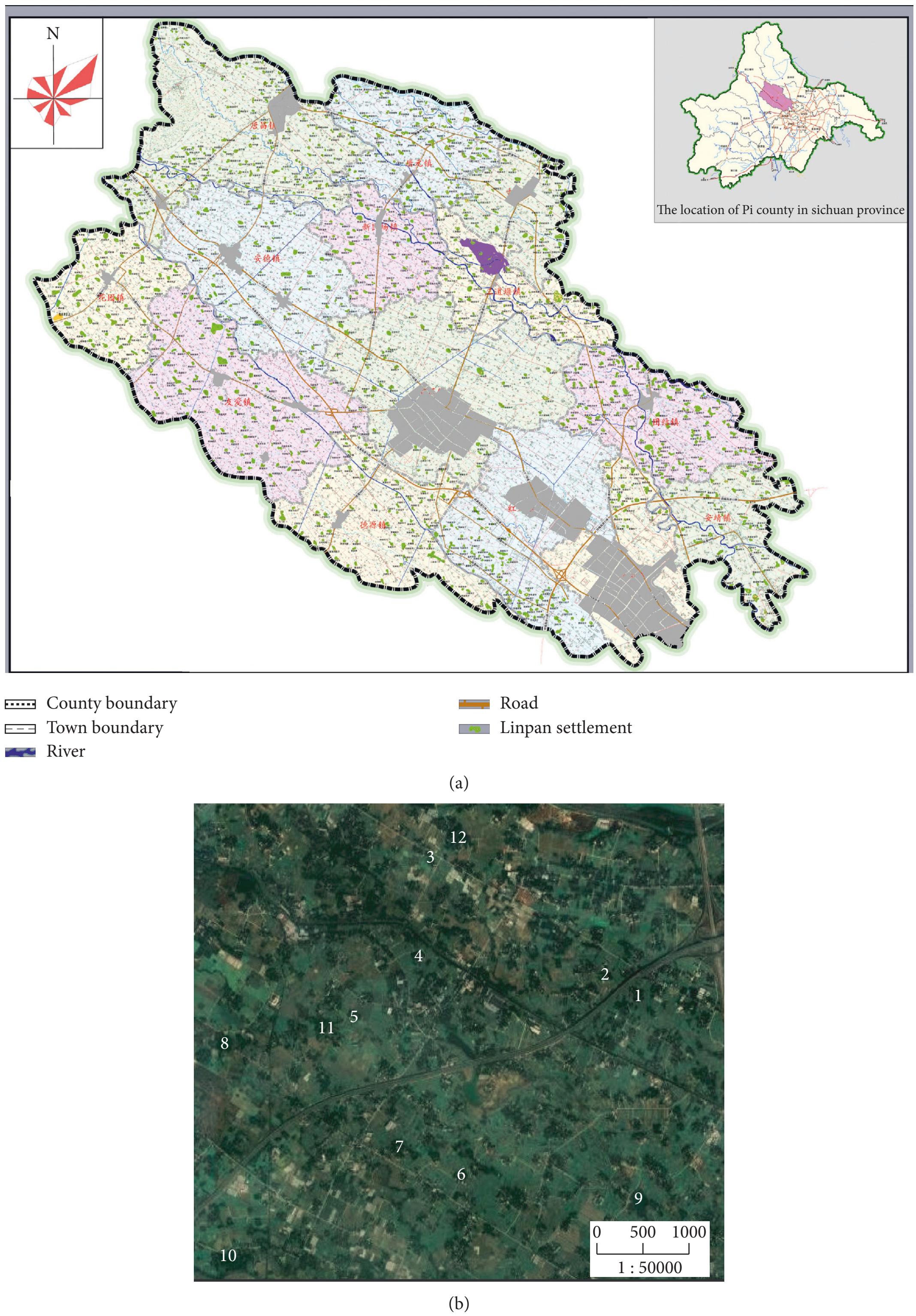


Figure 2: (a) The studied area in Sandaoyan town (purple area), Pi county, Chengdu Plain (base map from Pi County Planning and Construction Bureau); (b) the number of Linpan sample and its location (base map from Google Earth).

2.2. Identification of Linpan Characteristics. To prevent interference, the Linpan samples were selected so that they were all in a similar environment (surrounded by the same crops and away from water). The tree canopy coverage rates of the Linpan were around 70%. The main characteristics of the Linpan are recorded in Table 1. Depending on the horizontal position of the trees in the Linpans, the samples were divided into four distribution patterns (Figure 3). Three Linpan samples of each distribution pattern were used for investigation.

Table 1: Linpan characteristics.

Linpan number	Location (village)	Size (m^2)	Plant species	Tree distribution pattern
1	Qingta	2,301	*Sophora japonica* L., *Neosinocalamus* Keng f., and *Pterocarya stenoptera* C.	Surrounding
2	Qingta	3,048	*Metasequoia*, *Neosinocalamus* Keng f., and *Pterocarya stenoptera* C.	Surrounding
3	Qingta	3,796	*Pterocarya stenoptera* C. and *Camptotheca acuminata*	Central
4	Sanyan	4,234	*Cinnamomum camphora* L. and *Pterocarya stenoptera*	Unilateral
5	Qingta	4,704	*Metasequoia glyptostroboides* Hu, *Neosinocalamus* Keng f., and *Cinnamomum camphora* L.	Surrounding
6	Sanyan	4,929	*Metasequoia glyptostroboides* Hu and *Cinnamomum camphora* L.	Unilateral
7	Sanyan	5,125	*Pterocarya stenoptera* and *Neosinocalamus* Keng f.	Scattered
8	Qingta	5,268	*Pterocarya stenoptera* and *Eucalyptus robusta* Smith	Central
9	Qingta	5,784	*Pterocarya stenoptera* and *Cinnamomum camphora* L.	Central
10	Sanyan	5,848	*Neosinocalamus* Keng f. and *Pterocarya stenoptera*	Scattered
11	Qingta	6,243	*Pterocarya stenoptera*, *Firmiana platanifolia*, and *Camptotheca acuminata*	Scattered
12	Qingta	7,678	*Camptotheca acuminata*, *Neosinocalamus* Keng f., and *Cinnamomum camphora* L.	Unilateral

2.3. Micrometeorology Data Collection. Micrometeorology data were collected from three study locations of each Linpan: the outside, edge, and center. The outside location (abbreviated o) was defined as 10 m from the Linpan. The edge location (abbreviated e) is at the edge of the Linpan. The center location C (abbreviated c) is at the center of the Linpan. A portable Kestrel 4000 instrument (NK, Boothwyn, PA, USA) was used to record wind speed, air temperature, and relative humidity (Table 2). Solar radiation was collected using a CMP6 instrument (Kipp & Zonen, Netherlands). These instruments were installed horizontally 1.5 m above ground level. Seasonal micrometeorology parameters were automatically collected in 5 min intervals from 08 : 00 to 18 : 00 at April (spring), July (summer), October (fall), and January (winter). The measurement period covered two years (2016 and 2017).

2.4. Data Analysis Methods. Micrometeorology parameters were calculated for each measurement day, and an average value was calculated for the whole month. The survey results are presented as mean ± standard deviation (SD), and the pairwise differences in parameters among three points were calculated as follows: air temperature difference (abbreviation ΔT), $\Delta T_1 = T_o$ (outside) – T_e (edge), $\Delta T_2 = T_e - T_c$ (center), and $\Delta T_3 = T_o - T_c$. All data were analyzed using Duncan's multiple range tests implemented in SPSS (v. 11.0). Pearson's correlation analysis was used to identify the micrometeorology impact factors. Origin 8.0 was used to draw charts and for function fitting.

3. Results

3.1. Analysis of Seasonal Air Temperature of the Linpans. Table 3 shows the mean seasonal air temperatures (abbreviation T_{air}) of the Linpans between the outside and inside temperature fluctuations of 26.1–27.1°C in spring, 34.5–35.8°C in summer, 18.9–20.1°C in the fall, and 8.5–9.1°C in winter. The mean T_{air} showed a decreasing trend from the outside to the inside of the Linpan ($T_o > T_e > T_c$), as shown in Figure 4 and Table 3, over the four seasons. This confirms that the cooling effect was highest at the outside and decreased toward the inside of the Linpan in all seasons. The mean ΔT_3 was largest during summer and the fall (1.3°C, nonsignificant difference) and decreased gradually towards the winter (0.57°C) (Table 4). Detailed analysis (Figure 5) shows that ΔT_3 was positive in spring, summer, and the fall, which further confirms the cooling effect. In particular, in summer, ΔT_3 slowly increased with increasing Linpan size. On the other hand, in sample No. 8 (size, $>5\times10^3$ m^2), T_e and T_c increased, and a negative ΔT_{air} was even observed in winter. The phenomenon indicates that larger Linpan could have the warming effects in winter, and an area of 5.5×10^3 m^2 could be the lower limit of Linpan size at which the central temperature of the Linpan exceeds the temperature outside the Linpan in winter.

The tree distribution patterns had different effects on T_{air} in each season (Figure 6(a)). A scattered tree pattern resulted in the highest ΔT_3 in spring, summer, and the fall, but the lowest ΔT_3 (0) was observed in winter. The strongest cooling effect was observed in the three former seasons, while the best thermal insulation capacity in winter. In contrast, the surrounding pattern gave the weakest impact on T_{air} in the four seasons. In addition, the smallest influence on the T_e was observed in the central tree distribution.

3.2. Analysis of Seasonal Solar Radiation of the Linpans. The mean seasonal solar radiation flux (abbreviation SR) across the Linpans fluctuated between 46.5 and 381.1 W/m^2 in spring, 30.1 to 526.1 W/m^2 in summer, 37.2 to 244.8 W/m^2 in the fall, and 20.1 to 112.1 W/m^2 in winter (Table 3). A clearly decreasing trend in SR from the outside to the inside of the Linpans in all four seasons is shown in Figure 7. We also observed that $\Delta S_1 > \Delta S_2$, which indicates that SR interception was not evenly distributed. The greatest SR interception was observed at the edge of the Linpan. The mean ΔS_3 was the largest in summer, and about 500 W/m^2

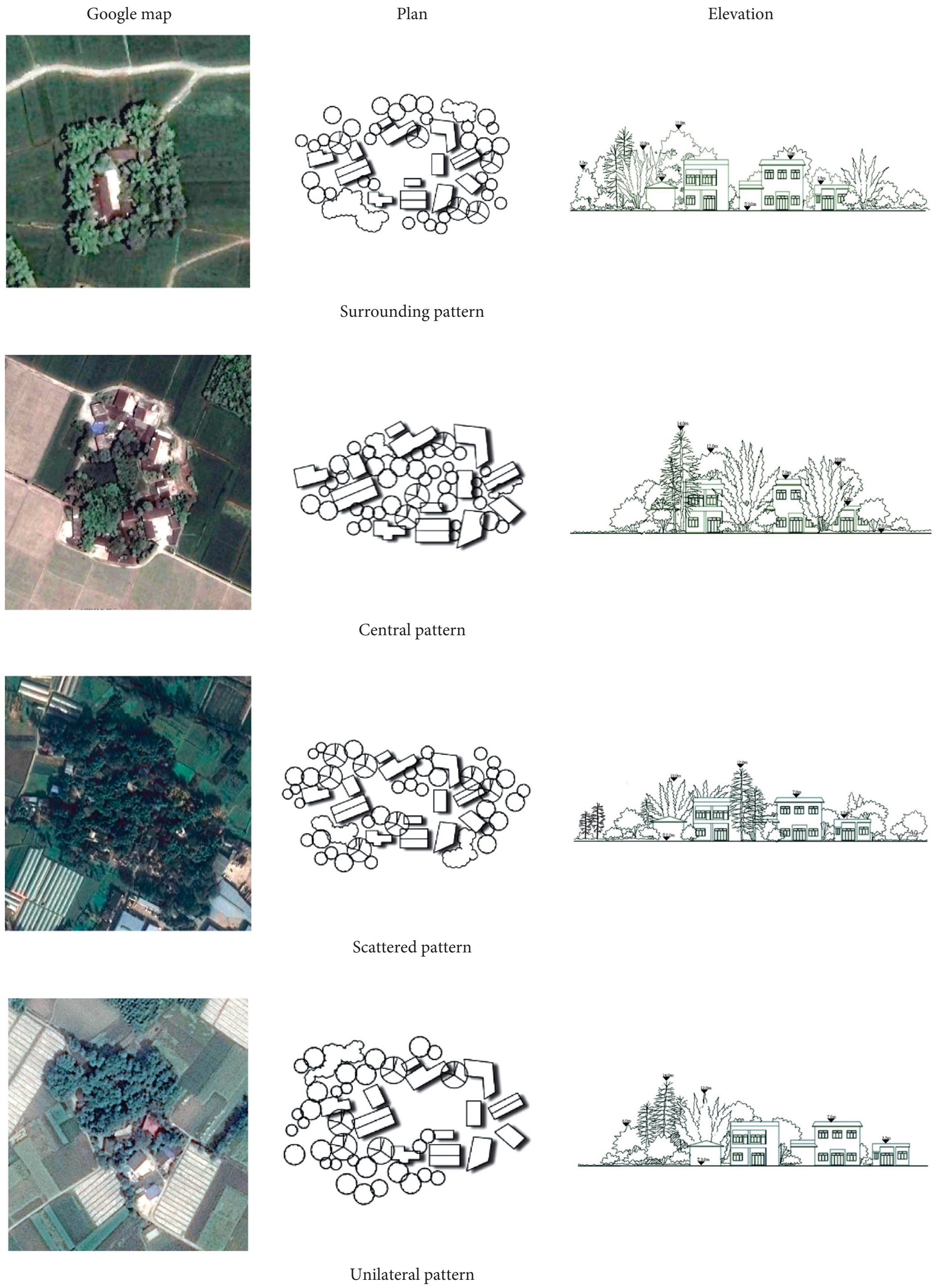


Figure 3: Tree distribution patterns of Linpan (drawing by author).

solar radiation was intercepted by the Linpan trees in summer, followed by those of spring, the fall, and winter (Table 4). Data analysis showed that the values of Linpan center were stable and low (from 20.5 to 46.5 W/m^2) throughout all seasons (Figure 7). This situation resulted in the stronger SR and the stronger SR interception ability by the Linpan trees.

The distribution of surrounding trees had the greatest impact on SR interception because the highest ΔS_3 values were consistently observed in this pattern in all seasons

Table 2: Sensor characteristics.

Instrument	Parameter	Accuracy	Operational range	Operating limits
Kestrel 4000	Air temperature Relative humidity Wind speed	±0.5°C ±3% ±1.04%	−29 to 70°C 0–100% 0.6–60 m/s	−30 to 80°C
CMP 6	Solar radiation	±5–20 μV/W/m^2	0–2,000 W/m^2	−40 to 80°C 0–100% RH

Table 3: Average seasonal values of the micrometeorology parameters.

Parameters		Spring	Summer	Fall	Winter
Air temperature (°C)	Outside	27.1 ± 0.7	35.8 ± 1.2	20.1 ± 0.9	9.1 ± 0.9
	Edge	26.1 ± 0.6	35.2 ± 1.2	19.5 ± 0.9	8.9 ± 0.6
	Center	26.1 ± 0.5	34.5 ± 1.0	18.9 ± 0.9	8.5 ± 0.5
Solar radiation (W/m^2)	Outside	381.1 ± 152.7	526.1 ± 70.8	244.8 ± 35.6	112.2 ± 40.3
	Edge	117.3 ± 33.6	215.4 ± 101.6	117.8 ± 58.7	48.0 ± 29.6
	Center	46.5 ± 15.1	30.1 ± 28.1	37.2 ± 30.5	20.1 ± 10.6
Relative humidity (%)	Outside	42.8 ± 4.2	79.7 ± 4.4	62.8 ± 3.6	53.3 ± 4.3
	Edge	44.8 ± 4.5	82.2 ± 5.5	64.4 ± 4.0	54.5 ± 4.0
	Center	44.5 ± 4.4	83.8 ± 5.2	65.2 ± 4.0	54.7 ± 2.4
Wind speed (m/s)	Outside	0.8 ± 0.4	0.6 ± 0.3	0.5 ± 0.3	0.8 ± 0.3
	Edge	0.6 ± 0.4	0.3 ± 0.3	0.2 ± 0.2	0.6 ± 0.3
	Center	0.5 ± 0.3	0.1 ± 0.1	0.1 ± 0.1	0.3 ± 0.3

Results are the seasonal mean value ± standard deviations.

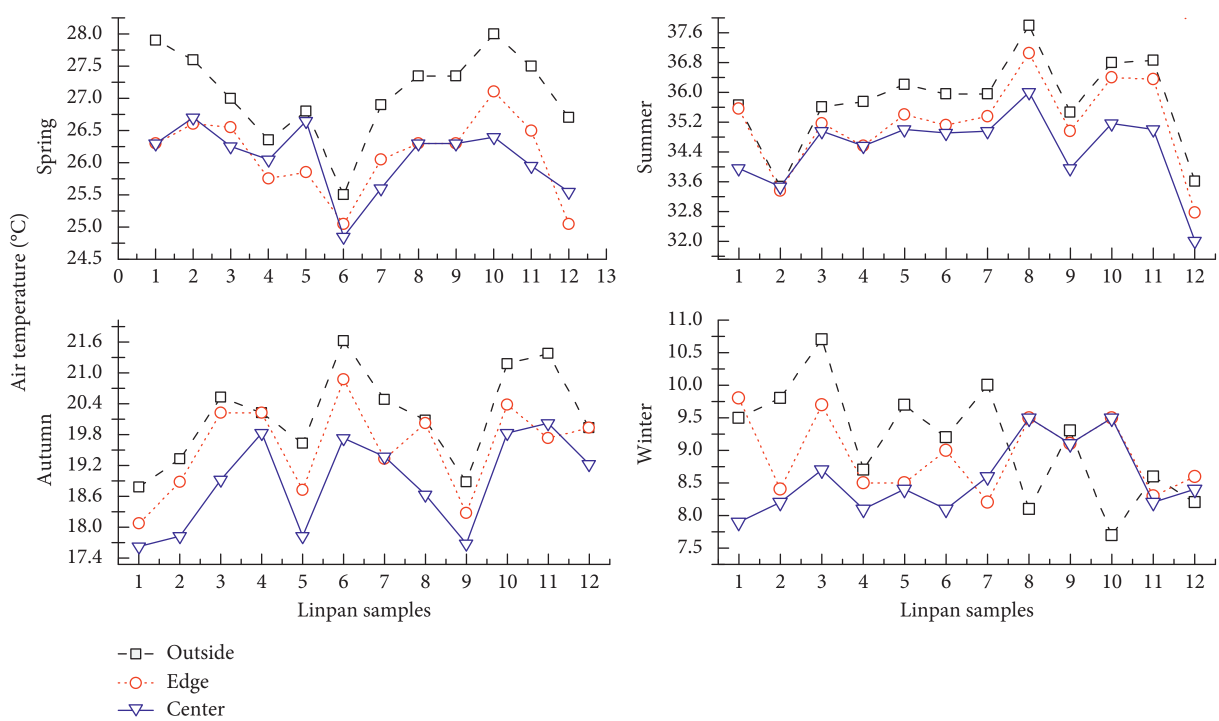


Figure 4: The seasonal air temperature of Linpan samples.

(Figure 6(b)), consistent with our findings that the SR was greatly reduced at the edge of Linpan. The scattered pattern showed a relatively uniform SR interception. On the basis of this analysis, the main factor affecting SR is the horizontal tree distribution. In addition, we also observed the inside temperatures of the Linpan were well matched with the shading conditions.

3.3. Analysis of the Seasonal Relative Humidity of the Linpans. The average relative humidity (abbreviation RH) across the Linpans ranged from 42.8% to 44.5% in spring, 79.7% to 83.8% in summer, 62.8% to 65.2% in the fall, and 53.3% to 54.7% in winter (Table 3). The summer RH was outside of the human comfort region (40–60%) [21]. As summarized in Figure 8, almost all the ΔRH_3 values were negative,

Table 4: Seasonal differences in the micrometeorology parameters.

Parameters	ΔT (°C)		ΔSR (W/m^2)		ΔRH (%)		ΔW (m/s)	
Spring	ΔT_1	0.9ab	ΔSR_1	263.8cd	ΔRH_1	−2.0b	ΔW_1	0.2cd
	ΔT_2	0.0e	ΔSR_2	70.8gh	ΔRH_2	0.4c	ΔW_2	0.2d
	ΔT_3	1.0ab	ΔSR_3	334.6b	ΔRH_3	−1.7bc	ΔW_3	0.4bc
Summer	ΔT_1	0.6cd	ΔSR_1	310.6bc	ΔRH_1	−2.5ab	ΔW_1	0.3bc
	ΔT_2	0.7cd	ΔSR_2	185.4ef	ΔRH_2	−1.6bc	ΔW_2	0.2cd
	ΔT_3	1.**3a**	ΔSR_3	496.**0a**	ΔRH_3	−4.**1a**	ΔW_3	**0.5a**
Fall	ΔT_1	0.6cd	ΔSR_1	127.0fg	ΔRH_1	−1.6bc	ΔW_1	0.2cd
	ΔT_2	0.7bc	ΔSR_2	80.6gh	ΔRH_2	−0.8bc	ΔW_2	0.7d
	ΔT_3	1.**3a**	ΔSR_3	207.6de	ΔRH_3	−2.4ab	ΔW_3	0.4bc
Winter	ΔT_1	0.2de	ΔSR_1	64.2i	ΔRH_1	−0.6bc	ΔW_1	0.2d
	ΔT_2	0.4de	ΔSR_2	27.9j	ΔRH_2	−0.3bc	ΔW_2	0.3bc
	ΔT_3	0.6de	ΔSR_3	92.1gh	ΔRH_3	−0.9bc	ΔW_3	**0.5a**

All values followed by letter are significantly different at $P \leq 0.05$ according to Duncan's test in SPSS. The different letters indicate there is statistically significant difference between the same group of variables.

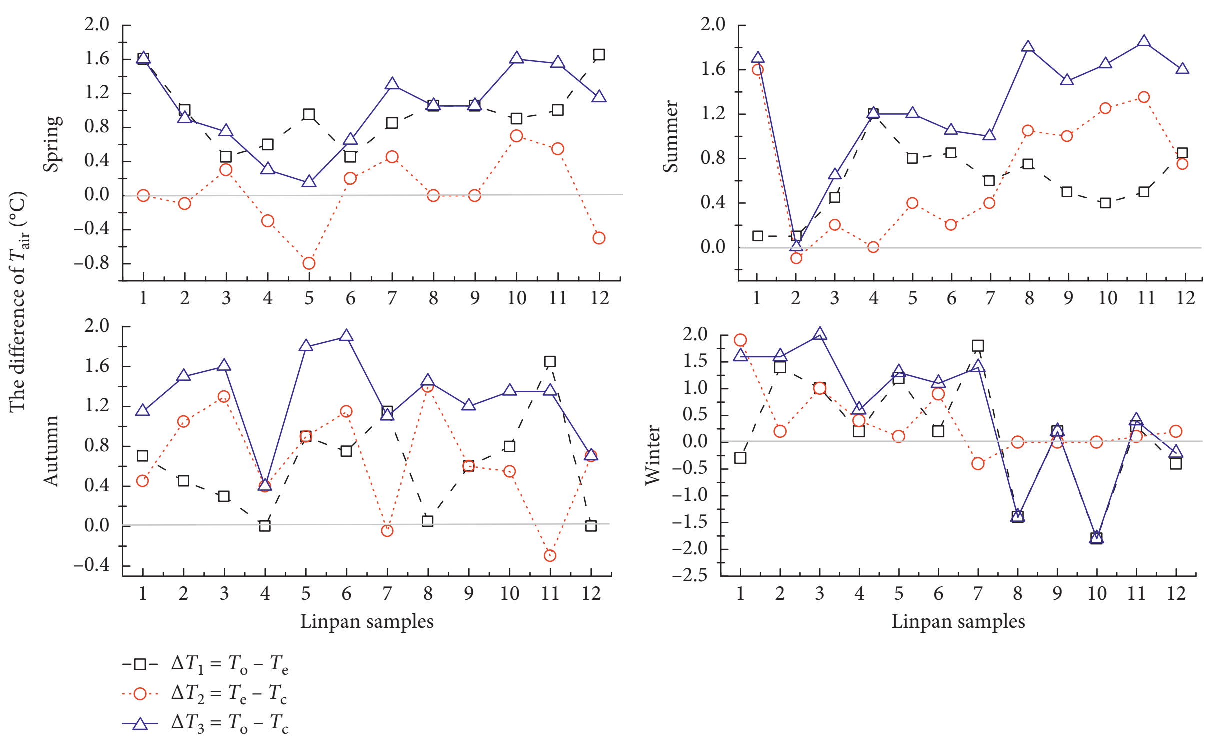


Figure 5: The seasonal temperature difference of Linpan samples.

indicating that the RH values at all central positions was higher than those outside the Linpans. The lowest and highest ΔRH_3 were observed in winter (0.9%) and summer (4.1%), respectively, and were significantly different. Moreover, Table 4 shows that the mean $|\Delta RH_1|$ is larger than $|\Delta RH_2|$, which indicates that the RH was greatly increased at the edge of the Linpan. There was an uneven increase in RH from the outside of the Linpan to the inside.

The scattered tree pattern showed the biggest ΔRH_3 in all seasons; moreover, well-distributed humidification was also observed with this tree distribution pattern from the outside to the inside of the Linpan (Figure 6(c)). On the other hand, the most uneven humidification was observed in the surrounding pattern.

3.4. Analysis of Seasonal Wind Speed in the Linpan Areas. The seasonal wind speed through the Linpan was relatively mild. A wind prevention effect by the Linpan vegetation was observed. From the Linpan outside to the inside, the average seasonal wind speed constantly decreased (Figure 9). The values ranged from 0.5 to 0.8 m/s in spring, 0.1 to 0.6 m/s in summer, 0.1 to 0.5 m/s in the fall, and 0.3 to 0.8 m/s in winter (Table 3). The maximum ΔW_3 was 0.5 m/s in summer and winter, but the lowest speed was 0.4 m/s in spring and the fall (Table 4), which indicates static air or a light breeze at the Linpan center. Wind speed did not weaken uniformly either in seasons, as shown in Table 4.

The tree distribution pattern strongly influenced the wind speed. The scattered pattern showed the optimal wind

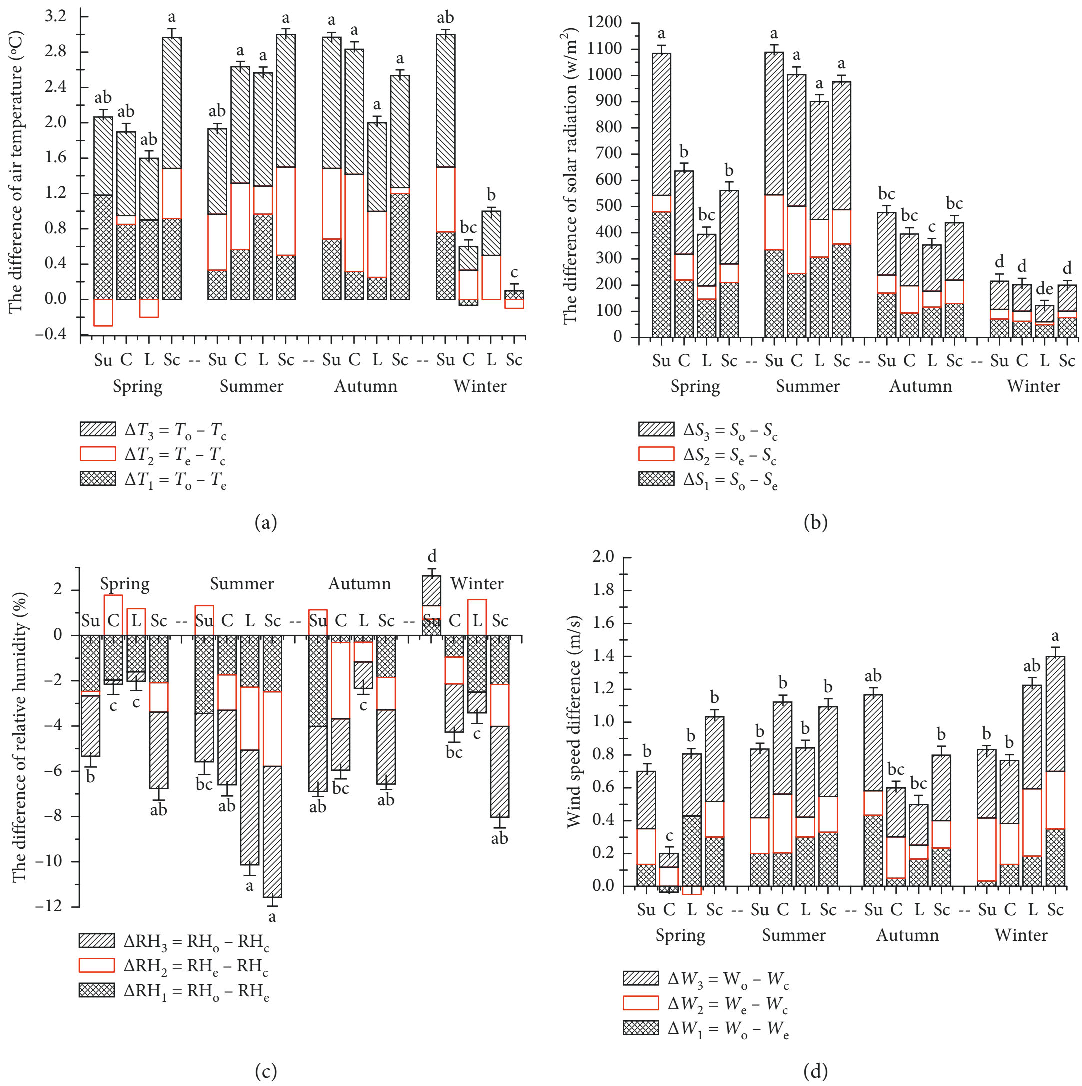


Figure 6: The seasonal micrometeorology parameters difference of Linpan with tree distribution patterns.

proofing effect in all seasons (Figure 6(d)), whereas the worst effect was observed for the central pattern. A dense, consistent, and uniform plant community was observed under the scattered trees, indicating that a horizontally and vertically uniform plant community could play an important role in wind protection.

3.5. Correlation between Linpan Size and Micrometeorology. To clarify the effect of the Linpan size on the seasonal micrometeorology, Pearson correlation and regression analysis were undertaken to describe the relationship between Linpan size and the various factors with the season (Table 5). Linpan size did not show any relationships with SR or wind speed in four seasons. However, the Linpan size was significantly correlated with T_{air} in summer and winter. Our findings confirm that the Linpan size could inversely effect Linpan T_{air} in extremely hot and cold seasons. Generally, as the Linpan size increased, T_{air} of Linpan center in summer decreased, whereas a higher T_{air} at the Linpan center occurred in winter. In addition, Linpan size was also significantly correlated with relative humidity in winter. As the Linpan size increased, the humidity difference between the outside and inside of the Linpan became smaller in winter. These relationships are presented using a one-dimensional linear regression equation (Figure 10).

4. Discussion and Conclusion

The optimal micrometeorology enhances human well-being, thereby affecting the use of space [22]. In general, our results reveal the unique micrometeorology of Linpans throughout the seasons, and we have confirmed the influence of Linpan size and tree distributions on the Linpan micrometeorology.

4.1. Linpan Micrometeorology. Lan et al. [23] reported that 25.3–26.3°C is the most comfortable air temperature for people in China. However, in the studied Linpan, the

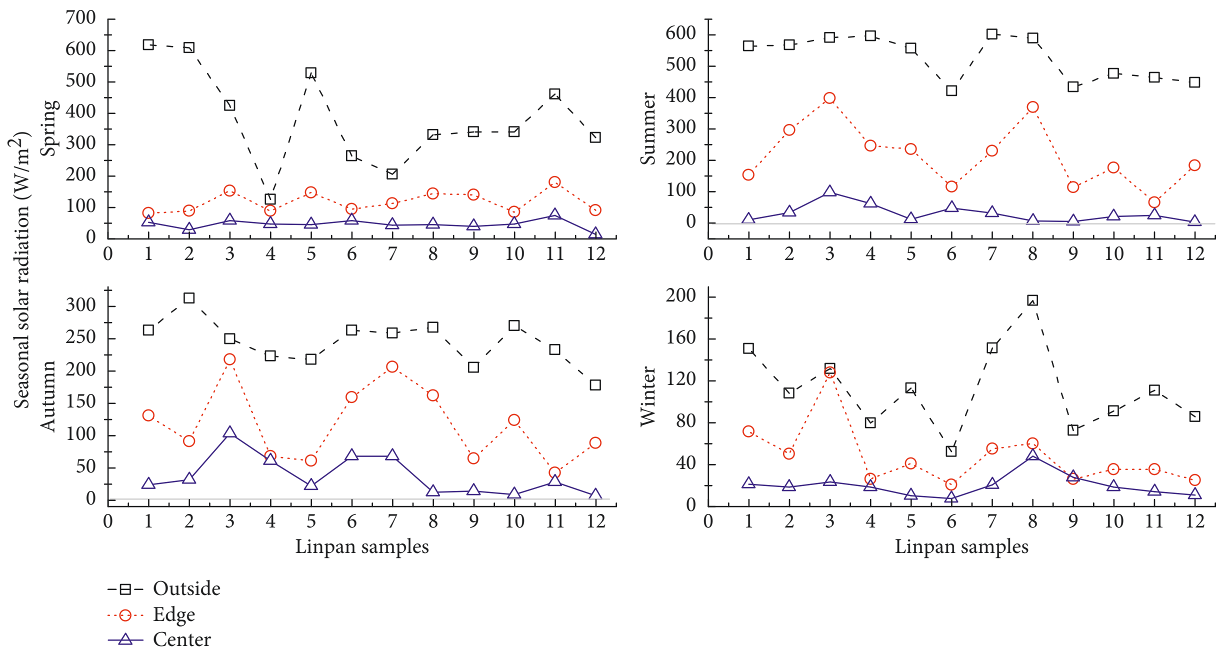


FIGURE 7: The seasonal solar radiation of Linpan samples.

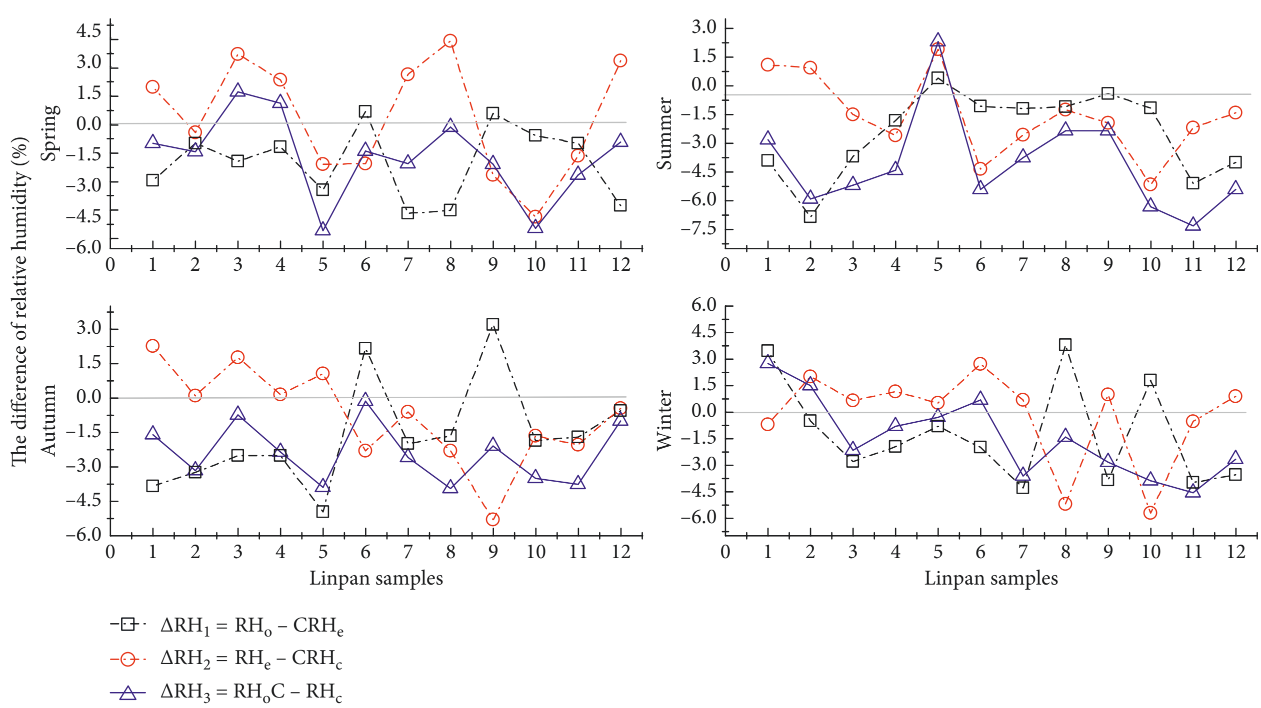


FIGURE 8: The seasonal relative humidity of Linpan samples.

majority of the seasonal T_{air} deviated from this range. In summer, the fall, and winter, the Linpan T_{air} were higher or lower than the comfortable range by more than 5°C, especially in winter. ΔT_3 of the studied Linpan ranged from 0.57 to 1.27°C over the seasons, which is smaller than the temperature reductions (3–6.9°C) in urban green spaces [20, 24, 25]. Additionally, we also found that the cooling effect of the Linpan decreased from summer to winter, even disappearing in winter, and the same trend has been observed previously. Hamada [26, 27] reported that the diurnal winter variation in temperature difference of green areas is not particularly noticeable, which is thought to be related to the reduced shade provided by deciduous trees. In contrast, suburban forests showed a warming effect during the

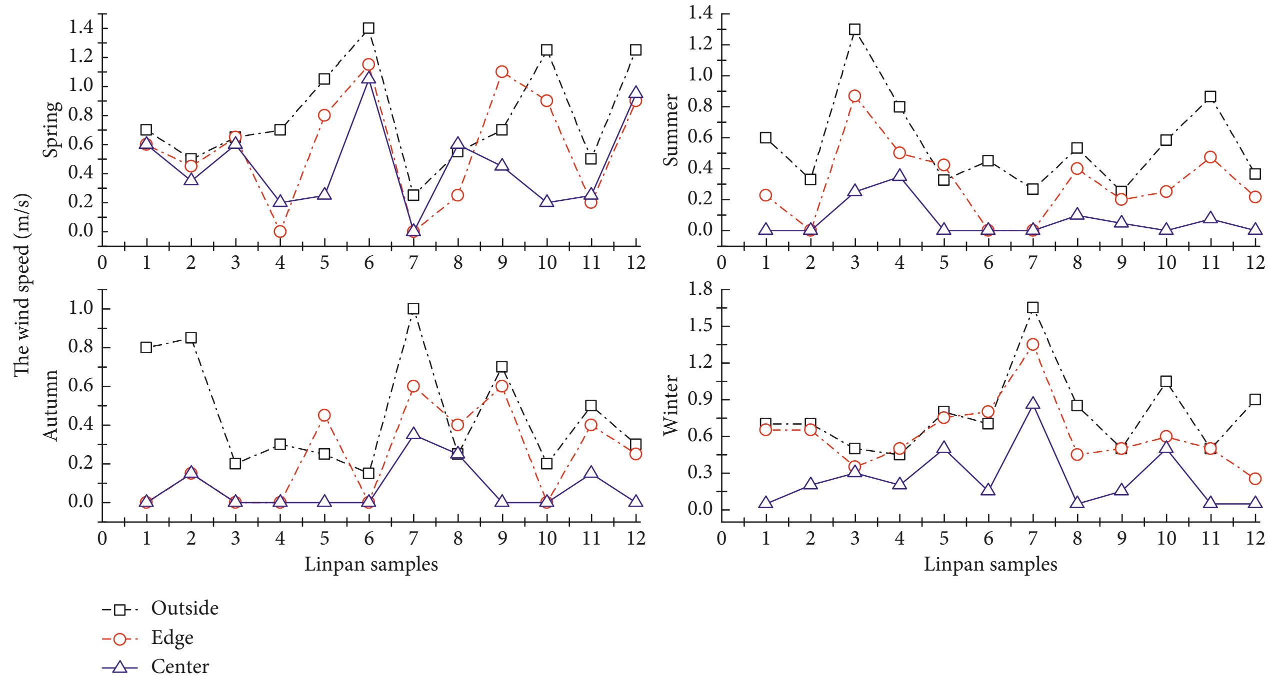


Figure 9: The seasonal wind speed of Linpan samples.

Table 5: Pearson correlation analysis between Linpan size and seasonal micrometeorology parameters.

	Spring			Summer			Fall			Winter		
Size	ΔT_1	ΔT_2	ΔT_3	ΔT_1	ΔT_2	ΔT_3	ΔT_1	ΔT_2	ΔT_3	ΔT_1	ΔT_2	ΔT_3
	0.11	0.05	0.14	0.45	0.23	**0.50***	0.07	−0.24	−0.21	0.37	**−0.62***	**−0.61***
Size	ΔSR_1	ΔSR_2	ΔSR_3	ΔSR_1	ΔSR_2	ΔSR_3	ΔSR_1	ΔSR_2	ΔSR_3	ΔSR_1	ΔSR_2	ΔSR_3
	−0.52	0.39	−0.44	−0.11	−0.27	−0.49	−0.14	−0.07	−0.26	0.11	−0.50	22120.307
Size	ΔRH_1	ΔRH_2	ΔRH_3	ΔRH_1	ΔRH_2	ΔRH_3	ΔRH_1	ΔRH_2	ΔRH_3	ΔRH_1	ΔRH_2	ΔRH_3
	−0.08	−0.15	−0.28	0.24	−0.47	−0.19	0.10	−0.11	0.00	−0.43	−0.19	**−0.76****
Size	ΔW_1	ΔW_2	ΔW_3	ΔW_1	ΔW_2	ΔW_3	ΔW_1	ΔW_2	ΔW_3	ΔW_1	ΔW_2	ΔW_3
	−0.09	−0.11	−0.11	−0.10	−0.13	0.13	−0.23	−0.25	−0.10	0.37	−0.11	0.29

Values followed by * are significantly different at $P \le 0.05$ and those followed by ** are significantly different at $P \le 0.01$ according to Duncan's test.

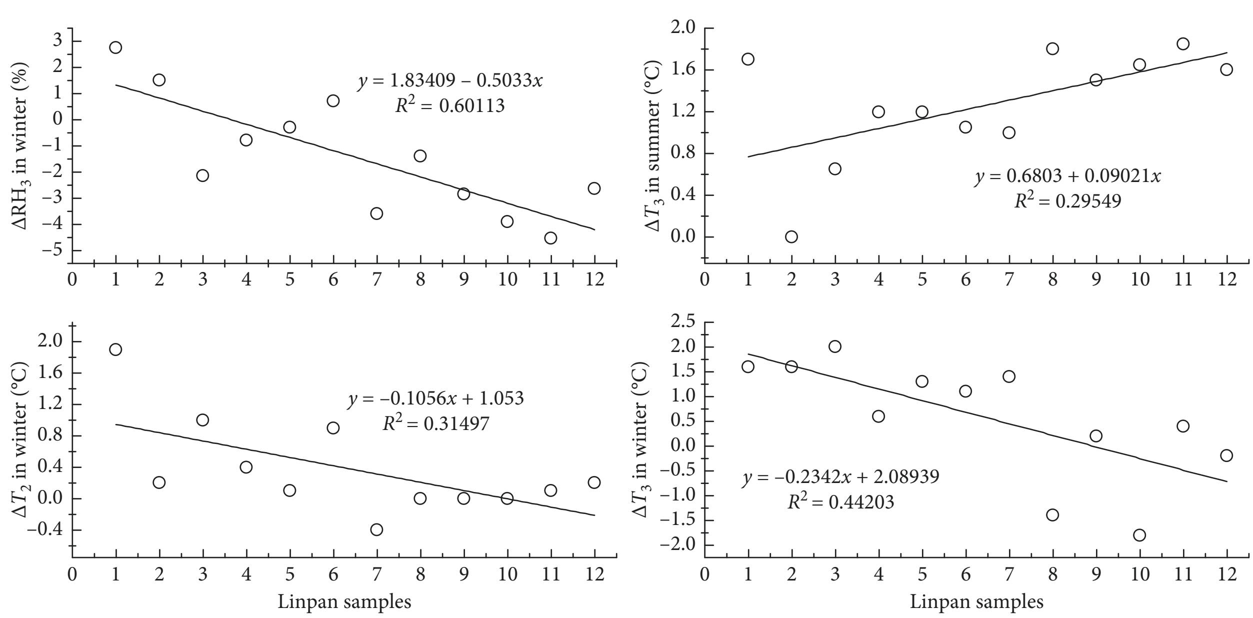


Figure 10: The linear relationship between Linpan size and micrometeorology parameters.

daytime compared to temperature in open fields in winter [28]. In addition, our results confirmed that the larger Linpans were warmer during the daytime in the winter. The Pearson correlation results confirmed that the larger Linpan could easily form a more comfortable temperature in extremely cold and hot seasons.

Solar radiation is the conventional heat source for Linpan residents and vegetation [29]. In our study, the SR value from the outside to the inside of the Linpans did not decrease uniformly in different seasons. Antoniadis et al. [30] determined that the tree canopy reduced the radiation by more than 90% in green spaces, but our data suggest that the tree canopies of Linpan only intercepted solar radiation by more than 90% in summer. The interception rate fluctuated by 80% in the other seasons. Generally, trees can prevent the risk of receiving acute and long-term damage associated with UV radiation exposure. However, there is no one-size-fits-all answer for how much sunshine is needed for the health of local residents because of differences in skin type, physique, and clothing. Considering that the Chengdu Plain has the lowest solar radiation intensity in China [31], a number of unshaded spaces should be supplied for Linpan residents.

In the Linpan interior, compared to the outside of the Linpan, there was a noticeable humidifying effect over the entire year. In summer, the RH values in the Linpan exceeded the comfortable range (40–60%) for people in China. In particular, a high RH can increase the apparent temperature for residents. In the studied Linpan, ΔRH ranged from 0.9% to 4.1%, which is lower than the values reported for subtropical urban parks (from 6.21% to 8.30%) and urban forests (from 9.1% to 12.4%) [32, 33]. The highest ΔRH was observed in summer, and it was similar to that in the urban green space [34, 35]. This can be attributed to the high transpiration rate of Linpan vegetation in the summer.

McPherson et al. [36] reported that vegetation enhances the seasonal energy saving by reducing the wind velocity (the "wind break" effect), and we found similar results: trees in the Linpan showed an important ability to prevent wind. As the wind passed through the Linpan, its speed was reduced by 50% to 90% of the open wind speed. In the center of Linpan, there was a typical calm area. The scattered pattern resulted in the best wind reduction, and a continuous mix of bushes and grasses under the scattered trees was beneficial in reducing wind speed. As reported by Zeng et al. [37], the abundant vertical structure of forests (e.g., species composition and configuration) also strengthens the resistance of individual tree stands to wind damage. Thus, our findings are different to that of Tamang et al. [28] and Ferreira [38], who indicated that one or two rows of trees were optimal to reduce 85% of the wind speed and modify the micrometeorology.

In summary, of the studied tree distribution patterns, the scattered pattern is the optimal tree distribution pattern for Linpan micrometeorology, yielding the optimal temperature preservation in winter and the cooling effect in other seasons. This tree distribution also manifested strong wind proofing and humidity maintenance effects. Furthermore, it resulted in a more uniform solar radiation reaching the inside of the Linpan.

4.2. How to Improve Linpan Micrometeorology. Based on our study, there are many ways to adjust Linpan micrometeorology. First, increasing the Linpan size to more than 5.5×10^3 m^2 should be an effective way to retain heat in winter and reduce heat in summer. Moreover, a scattered tree distribution should be used in the reconstruction of Linpans, which could create a most comfortable micrometeorology. Secondly, to decrease seasonal shade and indirectly increase fall and winter temperatures, native deciduous trees such as *Ginkgo biloba* L, *Scrophulariaceae*, *Diospyros kaki* Thunb., *Alnus cremastogyne* Burk., and *Quercus acutissima* Carruth. should be used to replace evergreen trees partially. Furthermore, trees replacing the umbrella-shaped canopy with a cylindrical crown that has a branching angle of less than 40°, such as *Populus alba* and *Metasequoia glyptostroboides*, are beneficial to avoid shade formation over the four seasons. Thirdly, pruning the shrubs and herbs in the undergrowth of the scattered trees was helpful for forming a ventilated environment, which could indirectly reduce the humidity in summer.

5. Prospects

Urbanization is a component of global change. Urban-rural development has increased significantly in China in the past ten years, and almost four-fifths of villages in the Chengdu Plain have either completed or are in the progress of reconstruction. Recently, rural environment design has focused on landscape aesthetics but ignored the local climate, traditional customs, and residents' preferences. Thus, we plan to continue to study the ecological mechanism of Linpan micrometeorology, such as the effects of green coverage and plant communities on the Linpan micrometeorology. This will be helpful for the protection and restoration of traditional Linpan, as well as for regional landscape design for new rural settlements.

Data Availability

All data used are measured by our team. The measure data used to support the findings of this study are included within the article and are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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