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Spatial Dataset of Ancient Ginkgo Trees in Luoyang Town, Suizhou, China (2023)

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Abstract: Analyzing the spatial distribution of ancient ginkgo trees (*Ginkgo biloba* L.) in Luoyang town, China, contributes to a comprehensive understanding of the geographical patterns of these important trees. This study aims to establishes a reliable foundation for rural revitalization projects and aids in the conservation and sustainable utilization of natural cultural heritage. The dataset is constructed based on the authors' investigations of ancient ginkgo trees in Luoyang town, incorporating a diverse range of heterogeneous data, such as elevation, topography, waterbodies, and roads. The resulting spatial distribution dataset of ancient ginkgo trees in Luoyang town, Suizhou, Hubei reveals that Luoyang town boasts a relatively high number and density of these trees, totaling 2,036 trees with geotagged locations. The spatial arrangement of these trees is influenced by factors such as topography, elevation, waterbodies, and roads, exhibiting a tendency to cluster in the southwestern part of Luoyang town. The dataset comprises information on (1) the distribution of ancient ginkgo trees, with attributes including geographic location, height, diameter at breast height (DBH), growth status, and ancient tree classification; (2) elevation classification data; (3) distance from roads; (4) statistical analyses of tree distribution relationships with changes in elevation, slope, and aspect; and (5) field investigation photos. The data is archived in .shp, .xlsx, .jpg, and .txt formats, consisting of 41 data files with a total size of 88.9 MB (compressed into one file, 83.2 MB).

Keywords: ancient ginkgo trees; dataset; spatial distribution; Luoyang town; natural cultural heritage

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Dataset Availability Statement:

The dataset supporting this paper was published and is accessible through the *Digital Journal of Global Change Data Repository* at: https://doi.org/10.3974/geodb.2024.01.03.V1 or https://cstr.escience.org.cn/CSTR:20146.11.2024.01.03.V1.

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[2] Huang, Y. H., Wang, Z. B., Wang, S. H., *et al*. Tree by tree dataset of ancient ginkgo biloba in Luoyang town, Suizhou, Hubei of China (2023) [J/DB/OL]. *Digital Journal of Global Change Data Repository*, 2024. https://doi.org/10.3974/geodb.2024.01.03.V1. https://cstr.escience.org.cn/CSTR:20146.11.2024.01.03.V1.

1 Introduction

Ginkgo (*Ginkgo biloba* L.), a member of the gymnosperm division and the Ginkgoaceae family, stands as the sole surviving species within the Ginkgoales suborder of the ginkgo order. It holds the distinction of being the oldest surviving gymnosperm plant following the Quaternary glacial movement. Presently, wild ginkgo are exclusively found in China[1].

Plant systematists posit that numerous gymnosperms emerged during the Carboniferous period; fossil evidence suggests the genesis of ginkgo-like plants in the Upper Carboniferous period, their progression through the Permian to the Late Triassic of the Mesozoic era, and significant prominence within plant groups by the Mesozoic's conclusion. However, the Late Cretaceous period ushered in abrupt climate changes, marking the decline of gymnosperms. As the Tertiary Period concluded and the Quaternary Period commenced, extensive glaciers formed in the Northern Hemisphere, and ginkgo-like plants in North America, Europe, Oceania, and South America faced extinction. Notably, China's glaciers were less pervasive than those in Europe, with the North China region experiencing relatively mild erosional effects. Consequently, this ancient and rare plant endured in China[2]. Areas such as Tianmu Mountain in Zhejiang, Shennongjia in Hubei, and the Dabie Mountains at the junction of Anhui, Hubei, and Henan provinces experienced minimal glacier erosion, preserving wild or semi-wild ginkgo trees to this day.

Suizhou, situated in the northern part of Hubei province, stands out as the most conducive environment for ginkgo growth; its optimal climate, soil quality, and vegetation conditions create an ideal habitat for the natural growth and reproduction of ginkgo. The unique topography of Suizhou, hindering the invasion of cold currents since the end of the Tertiary Period, has made it one of the few areas with natural, wild ginkgo globally[3]. Luoyang town in Suizhou hosts a natural ancient ginkgo community—one of the densest, largest, and best-preserved in the world, boasting exceptional natural and cultural value. The establishment of the spatial distribution dataset of ginkgo trees in Luoyang town contributes to the conservation of plant species, biodiversity exploration, ecological balance, and understanding dynamic changes in plant communities in the region. This dataset serves as a scientific foundation for future protection and management while supporting in-depth research on ancient ginkgo communities that, in turn, aids local rural revitalization efforts. Analyzing the spatial distribution of these ancient trees and their influencing factors unveils the intrinsic links between rural development and natural cultural heritage, offering insights into models and approaches for leveraging natural cultural heritage to drive rural revitalization.

This study aims to investigate the relationships between the spatial distribution of *G. biloba* ancient trees in Luoyang town and various other factors. By constructing the dataset, this study intends to provide support and inspiration for the protection and development of ancient ginkgo communities and foster sustainable development in rural areas.

2 Metadata of the Dataset

The metadata of the dataset[4] described here are summarized in Table 1.

3 Methods

3.1 Data Development

The spatial data of ancient ginkgo trees in Luoyang town were acquired through on-site field collection. The on-site survey yielded comprehensive data for 2,036 trees, including

Table 1 Metadata summary of the dataset of Ginkgobiloba_LuoyangTown

Items	Description
Dataset full name	Tree by tree dataset of ancient ginkgo biloba in Luoyang town, Suizhou, Hubei of China (2023)
Dataset short name	Ginkgobiloba_LuoyangTown
Authors	Huang, Y. H., Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, huangyaohui0025@igsnrr.ac.cn Wang, Z. B., Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, wangzb@igsnrr.ac.cn Wang, S. H., Aerospace Information Research Institute, Chinese Academy of Sciences, wangshaohua@aircas.ac.cn Xu, D. C., Lanzhou Jiaotong University, 12232104@stu.lzjtu.edu.cn Li, X., Lanzhou Jiaotong University, 11220869@stu.lzjtu.edu.cn Zhou, J. Y., Lanzhou Jiaotong University, 11220851@stu.lzjtu.edu.cn
Geographical region	Suizhou city, Hubei province, China
Years	2023
Data formate	.shp, .xlsx, .jpg, .txt
Data size	88.9 MB
Data files	A total of 41 data files
Foundations	Chaoyang District in Beijing (E2DZ050100)
Data computation environment	ArcGIS, Excel
Data publisher	Global Change Research Data Publishing & Repository, http://www.geodoi.ac.cn
Address	No. 11A, Datun Road, Chaoyang District, Beijing 100101, China
Data sharing policy	(1) ***Data*** are openly available and can be freely downloaded via the Internet; (2) End-users are encouraged to use ***Data*** subject to citation; (3) Users, who are by definition also value-added service providers, are welcome to redistribute ***Data*** subject to written permission from the GCdataPR Editorial Office and the issuance of a ***Data*** redistribution license; and (4) If ***Data*** are used to compile new datasets, the 'ten per cent principal' should be followed such that ***Data*** records utilized should not surpass 10% of the new dataset contents, while sources should be clearly noted in suitable places in the new dataset[5]
Communication and searchable system	DOI, CSTR, Crossref, DCI, CSCD, CNKI, SciEngine, WDS/ISC, GEOSS

information on their location, village name, growth characteristics, protection level, and other relevant details.

Topographical data for Luoyang town were obtained using Digital Elevation Model (DEM) data with a resolution of 30 m, sourced from the Japan Aerospace Exploration Agency (JAXA[1]). The DEM data underwent processing in ArcGIS 10.8 Geographic Information System software to extract information on slope, aspect, and relief within the study area. Administrative boundary data for Luoyang town were retrieved from the National Geographic Information Resource Catalog Service System[2]. Utilizing the D8 algorithm and a flow model based on DEM data, waterbody data for Luoyang town were calculated, and the reliability of these data was verified through on-site inspections. Road data were sourced from the OpenStreetMap open-source map database[3]. All collected data were referenced to the CGCS-2000 coordinate system for consistency and accuracy.

Following the data-acquisition process, the spatial distribution data of ancient ginkgo trees in Luoyang town along with topographical, hydrological, road, and basic geographical spatial data underwent standardization. These datasets were then overlaid and subjected to spatial analysis to extract multidimensional characteristics.

3.2 Technical Approach

Data were gathered from three key perspectives—the distribution of ancient ginkgo trees in

[1] Topographic data. https://www.eorc.jaxa.jp/ALOS/en/aw3d30/data/index.htm.

[2] Administrative division boundary data. https://www.webmap.cn.

[3] Road data. https://www.openstreetmap.org.

Luoyang town, the current geographical data for the town, and surrounding environmental data (Figure 1). Employing Microsoft Office Excel 2016 and ArcGIS 10.8 software, the data were systematically organized, classified, and overlaid. This process yielded the multidimensional features defining the current spatial distribution of the trees. By synthesizing information from the 2,036 records, a comprehensive dataset was established, constituting the dataset of Ginkgobiloba_LuoyangTown. This dataset was then used to explore the interrelationships between tree distribution and geographical factors such as altitude, topography, and waterbodies.

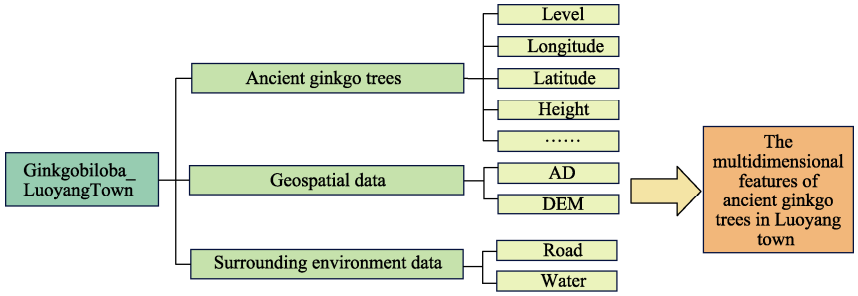

Figure 1 Technical roadmap for constructing the dataset of Ginkgobiloba_LuoyangTown

4 Data Results and Validation

4.1 Data Composition

The dataset is archived in .shp, .xlsx, .jpg, and .txt formats. For details regarding the data content and descriptions represented by each field in the dataset of Ginkgobiloba_LuoyangTown (.shp) file, please refer to Table 2.

Table 2 Composition of the dataset

Field names	Data content	Data description
ID	Number	Tree number
Species/SpeciesCN	Tree species	Tree species (Latin/Chinese name)
Village/VillageCN	Village name	Village name
Longitude	Longitude	Longitude of the geometric center of the ancient ginkgo tree
Latitude	Latitude	Latitude of the geometric center of the ancient ginkgo tree
Height	Tree height/m	Latitude of the geometric center of the ancient ginkgo tree Special value*: 99.9 m
Level/LevelCN	Level	Grade 1: growth exceeding 500 years; Grade 2: growth between 300 and 499 years; Grade 3: growth between 100 and 299 years[6]
Dbh	Diameter at breast height/cm	Diameter at breast height (DBH) of the ancient ginkgo tree
Growth/GrowthCN	Growth status	Growth status of the ancient ginkgo tree

*: 99.9 m indicates no data for tree height values.

4.2 Data Products

4.2.1 Tree Distribution

The spatial distribution of ancient ginkgo trees in Luoyang town is illustrated in Figure 2. Latitude and longitude geographic information were obtained for 2,036 trees more than a century

old. Predominantly, these trees are distributed in the southwest region of Luoyang town.

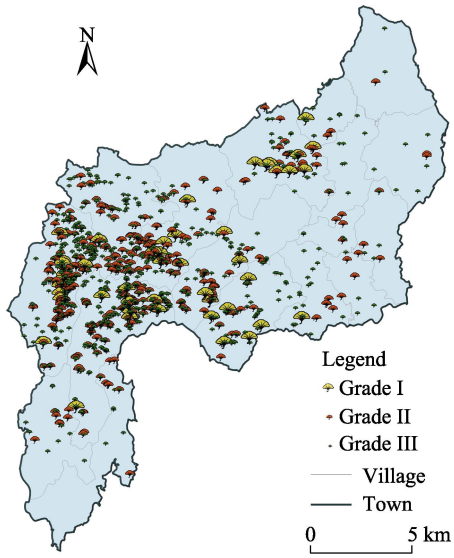

Figure 2 Distribution map of ancient ginkgo trees in Luoyang town

4.2.2 Statistical Evaluation

A comprehensive analysis of the characteristics of the 2,036 ancient ginkgo trees in Luoyang town was undertaken based on thorough on-site surveys. By conducting in-depth interviews with residents and elderly villagers residing near these trees, the ages of the trees were estimated. According to the dataset, the minimum age of any individual tree in the dataset is 100 years and the maximum age is 1,200 years with an average of 238.9 years. The minimum height of the trees is 4.7 m, the maximum height is 28.3 m, and the average height is 15.6 m. The minimum diameter at breast height (DBH) is 52 cm and the maximum DBH is 880 cm, with an average of 224.7 cm.

The majority of the trees fall within the age range of 100–352 years, the height range of 4.7–26.4 m, and the DBH range of 114–411 cm. Notably, a correlation was identified between the age, height, and DBH of the ancient trees, providing valuable insights into their growth patterns and interdependencies.

4.2.3 Relationships with Altitude

The coupling and overlaying of the DEM data with the spatial distribution dataset revealed a robust correlation with altitude (Figure 4). Using the Extract Values to Points function, elevation values were extracted for the locations of each tree in the dataset, and a histogram depicting the height distribution of these trees was generated (Figure 3). According to this analysis, ancient ginkgo trees in Luoyang town are distributed at altitudes ranging from 50 to 450 m, with a concentration at 150–250 m above sea level. Grouping the ancient trees based on altitude revealed that these trees initiate growth above 76 m, with only 1.67% distributed between 50 and 100 m above sea level. Thus, the number of ancient ginkgo trees increases with altitude. A significant proportion of the trees, 14.03%, occur between 100 and 150 m above sea level, gradually increasing within this altitudinal range, and the majority thrive between 150 and 200 m (38.13%) and between 200 and 250 m (38.76%). The highest concentration of ancient trees occurs at an altitude of approximately 188 m, while with a further increase in altitude, the number sharply declines; trees found at 250–300 m constitutes only 6.08% of the total records, representing an 84.31% reduction compared to

the previous altitudinal group. At even higher altitudes, the number of trees decreases notably with proportions of 1.13%, 0.10%, and 0.10% for altitudes of 300–350 m, 350–400 m, and 400–450 m, respectively. The highest altitude at which a ginkgo tree was observed is 417 m (Table 3).

Table 3 Altitudes of the ancient ginkgo trees in Luoyang town

Altitude (m)	Number of ancient ginkgo trees	Percentage (%)
<50	0	0.00
50–100	34	1.67
100–150	286	14.03
150–200	776	38.13
200–250	789	38.76
250–300	124	6.08
300–350	23	1.13
350–400	2	0.10
400–450	2	0.10
>450	0	0.00

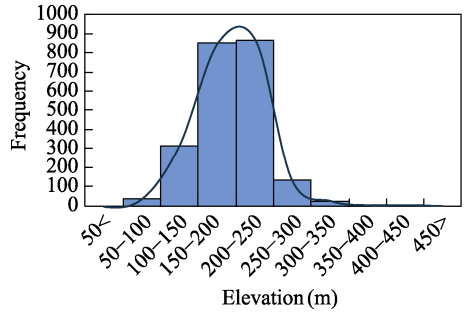

Figure 3 Altitudinal distribution of ancient ginkgo trees in Luoyang town

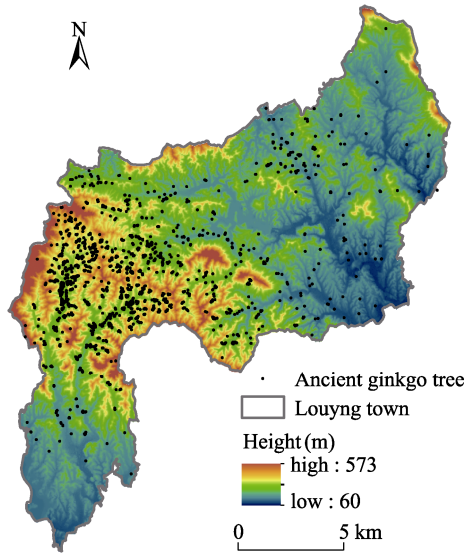

Figure 4 Distribution map of ancient ginkgo trees with altitude in Luoyang town

4.2.4 Relationships with Slope

Terrain slope directly influences soil fertility and water retention[7]. To explore the relationship between the spatial distribution of the trees and slope, extracted slope values were reclassified into the following six categories: gentle (0°–5°), gradual (5°–15°), inclined (15°–25°), steep (25°–35°), sharp (35°–45°), and hazardous (above 45°) slopes, aligning with slope classification standards. Converting slope data into vector data, vector patches of the same type were merged into the six categories. Based on spatial connection, the numbers of ancient ginkgo trees after the classification were then determined.

According to the analysis, the trees are mainly distributed on gradual slopes (5°–15°), accounting for 58.22% of the overall distribution. With a decrease or increase in slope, the number of trees gradually decreases; however, the number of trees on inclined slopes

(15°–25°) is relatively higher than that on gentle slopes (0°–5°), accounting for 27.25% and 11.98%, respectively. With a further increase in slope angle, the numbers of trees continue to decreases. Only 2.50% of ancient ginkgo trees are found on steep slopes (25°–35°), and only one was recorded on a sharp slope (35°–45°), with no occurrences on slopes > 45°. Thus, the distribution of these trees in Luoyang town is closely related to the slope of the terrain (Table 4, Figures 5 and 6).

Table 4 Slope statistics for the spatial distribution of ancient ginkgo trees in Luoyang town

Slope classification	Number of ancient ginkgo trees	Percentage (%)
Gentle slope	244	11.98
Gradual slope	1,185	58.22
Inclined slope	555	27.25
Steep slope	51	2.50
Sharp slope	1	0.05
Hazardous slope	0	0.00

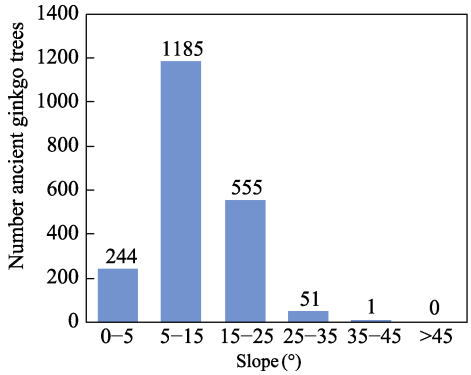

Figure 5 Slope distribution of ancient ginkgo trees in Luoyang town

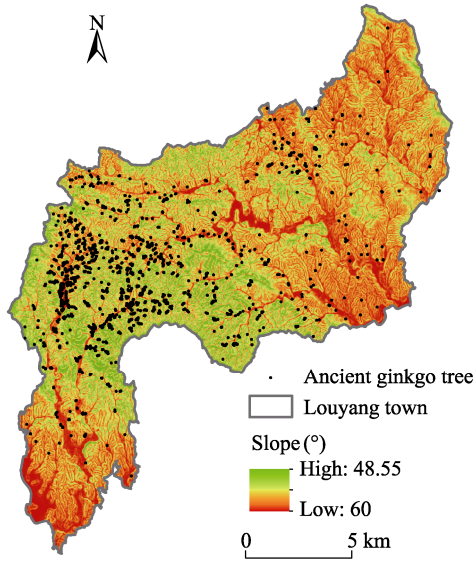

Figure 6 Distribution map of ancient ginkgo trees with land slope in Luoyang town

4.2.5 Relationships with Slope Aspect

Hilly mountainous areas are considerably influenced by slope aspect, resulting in distinct ecological environments, i.e., shady and sunny slopes, with a varying microclimate and ecological factors including light, heat, and water across slopes[8]. These differences directly impact the distribution, growth, development, yield, and quality of forest plants. To investigate the relationships between the spatial distribution of the trees and slope aspect, slope aspect was represented by positive degrees from 0° to 360°, measured clockwise with north as the reference direction. Following standard procedures, the extracted slope aspect values were reclassified into the following five categories: 0°–45° (shady slope), 45°–135°

(semi-shady slope), 135°–225° (sunny slope), 225°–315° (semi-sunny slope), and 315°–360° (shady slope). These categories were converted into vector data, and patches of the same type were merged into the aforementioned five categories. Through spatial connection, the numbers of ancient ginkgo trees within each classification were then obtained (Table 5).

As depicted in Figure 7, the trees are primarily distributed on semi-shady slopes followed by sunny slopes. However, the distinction between shady and sunny slopes is not highly pronounced; semi-shady, sunny, shady, and semi-sunny slopes account for 29.20%, 26.61%, 24.60%, and 19.59%, respectively.

Various slope aspects can lead to differences in climatic conditions, such as sunlight, temperature, humidity, etc., between shady and sunny slopes. However, these interactions are intricate, influenced not only by latitude and longitude but also by the vertical height of the slope[9]. While this study solely explored the correlation between the distribution of ancient ginkgo trees and slope, it is evident that a certain correlation exists (Figures 7 and 8).

Table 5 Aspect statistics of the spatial distribution of ancient ginkgo trees in Luoyang town

Aspect classification	Number of ancient ginkgo trees	Percentage (%)
0°–45°(Shady slope)	257	12.62
45°–135°(Semi-shady slope)	595	29.20
135°–225°(Sunny slope)	541	26.61
225°–315°(Semi-sunny slope)	399	19.59
315°–360°(Shady slope)	244	11.98

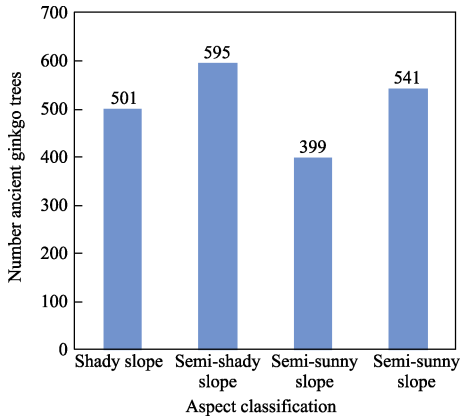

Figure 7 Distribution of ancient ginkgo trees in Luoyang town with slope aspect

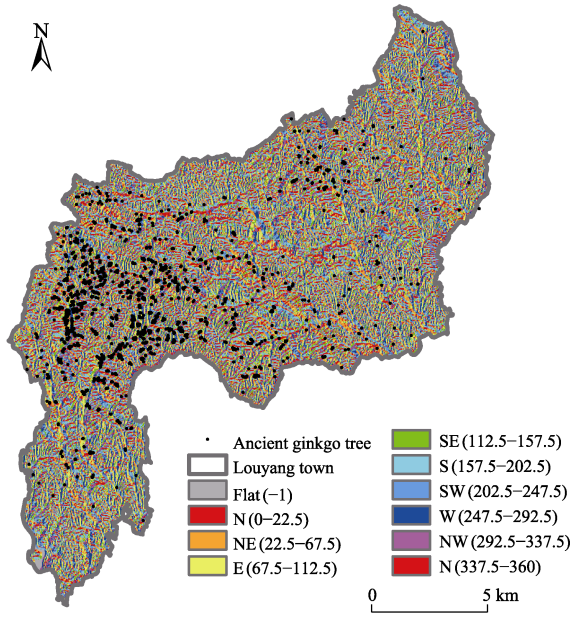

Figure 8 Distribution map of ancient ginkgo trees with aspect in Luoyang town

4.2.6 Relationships with Waterbodies

Water availability is the primary limiting factor for plant distribution and growth[10]. Environmental stressors such as drought, high temperatures, and low temperatures can disrupt plant water metabolism, leading to cellular dehydration and affecting crop growth. Ginkgo, growing in hilly and mountainous areas, is particularly susceptible to water stress[11]. Therefore, by extracting water system data for Luoyang town, we explored the relationships between the distribution of the trees and their distance from waterbodies.

As shown in Figure 9, the ancient ginkgo trees are clustered in the southwest. This clustering remains evident even in areas further away from waterbodies, while the regions closer to waterbodies appear to support fewer trees. The majority of the trees in the database are distributed within 3,000–7,000 m of waterbodies.

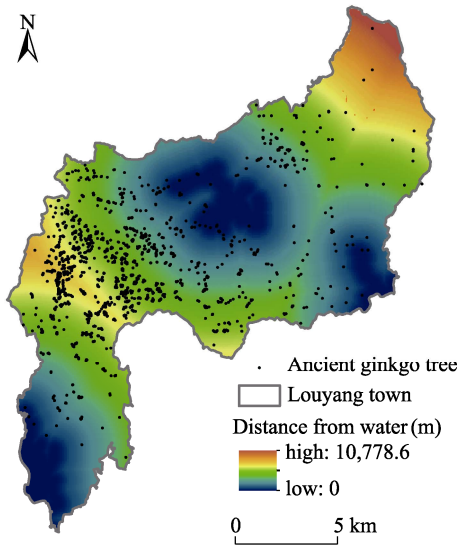

Figure 9 Distribution map of ancient ginkgo trees distance with distance from waterbodies in Luoyang town

4.2.7 Relationships with Roads

Ancient trees and villages beautifully exemplify the seamless integration of nature and human activities, showcasing a distinctive symbiotic relationship. This harmony is evident not only in the preservation of the natural environment but also in maintaining a delicate equilibrium between road construction and the conservation of natural cultural heritage. Through the analysis of road data for Luoyang town, we aimed to explore the current interplay between the spatial distribution of these trees and transportation roads.

As depicted in Figure 10, numerous trees occur along the main roads of villages in Luoyang town, standing out as prominent landmarks in the local rural scenery. Going forward, local authorities can strategically incorporate these ancient trees into cultural tourism routes through meticulous planning, fostering the sustainable development of rural economies. Simultaneously, in rural development initiatives, it is paramount to strike a careful balance between safeguarding ancient ginkgo trees and the construction of new transportation roads. Considering the current distribution of these trees, preserving them, implementing sensible protective measures, and ensuring that road construction has no

adverse impacts are crucial components of this delicate balance.

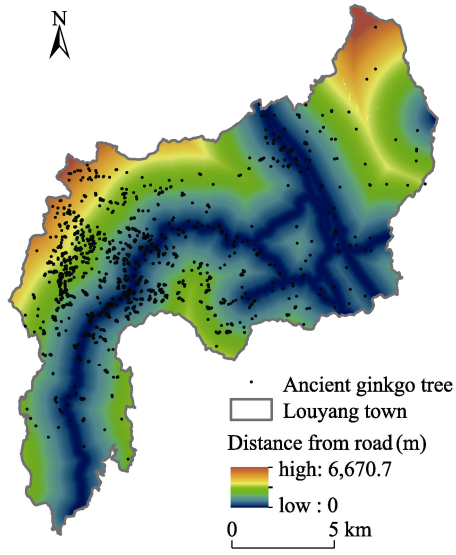

Figure 10 Distribution map of ancient ginkgo trees with distance from road system in Luoyang town

5 Discussion and Conclusion

The dataset of Ginkgobiloba_LuoyangTown stands out for its integration of diverse data sources, drawing from comprehensive on-site investigations. This dataset represents the world's most densely populated, extensive, and well-preserved community of ancient ginkgo trees. Through this dataset, we analyzed the spatial distribution and influencing factors of existing trees in Luoyang town. This, in turn, enriches our understanding of the regional distribution of ancient ginkgo trees in China and contributes to a nuanced geographical perspective on the characteristics of ginkgo tree populations.

The morphological characteristics, spatial distribution, and factors influencing these trees can be summarized as follows:

(1) Luoyang town is home to a total of 2,036 ancient ginkgo trees, for which latitude and longitude were obtained, which demonstrate a relatively high quantity and density.

(2) The spatial distribution of the trees is influenced by multiple factors such as topography, elevation, waterbodies, and roads. These trees are primarily distributed in the southwest part of Luoyang town, and their spatial distribution is significantly affected by elevation and topography; over 76% of the ancient ginkgo trees are located 150–250 m above sea level, and more than 85% occur on gradual and inclined slopes.

It is important to note that due to inherent limitations, there may be some bias and omissions in the statistical analyses reported here. To obtain more precise data, further collaboration with local governments is essential. Future research directions include expanding the research scope to a macro level, utilizing technologies like artificial intelligence and remote sensing interpretation to establish datasets for the ginkgo tree communities in Luoyang town and nationwide. At a micro level, a combination of quantitative and qualitative methods should be employed to analyze the local characteristics of ginkgo tree distributions, with an emphasis on exploring the mechanisms behind their spatial patterns.

Author Contributions

Huang, Y. H. designed the dataset; Huang, Y. H. and Wang, Z. B. collected and processed the spatial data; Huang, Y. H. designed the model and algorithms; Huang, Y. H., Wang, Z. B., Wang, S. H., Xu, D. C., Li, X., and Zhou, J. Y. performed data validation; Huang, Y. H., Wang, Z. B., Wang, S. H., Xu, D. C., Li, X., and Zhou, J. Y jointly wrote and revised the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest.

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