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# Spermatophyte Flora Distribution in Hubei Daqi Mountain Nature Reserve

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**Abstract** A basic ingredient analysis of flora and geographic elements of plant genera and families in Daqi Mountain Nature Reserve was conducted through the field survey and specimen collection, based on the system investigation of plant flora, and an R/T ratio comparison between the flora in Daqi Mountain and adjacent mountain floras was made. Plant taxonomy identification indicates that spermatophytes in the nature reserve comprises 1035 species of 534 genera, falling in 140 families, of which 10 gymnosperm species of 8 genera fall in 5 families, while 1025 angiosperm species of 526 genera in 135 families. The analysis of flora demonstrates that the region harbors 15 flora distribution types, with high complexity, paleo-flora origin, distinct trait of temperate zone, abundant ingredient of tropical zone, and close connection with the flora of East China.

**Key words** Spermatophyte, Flora, Geographical element

Hubei Daqi Mountain Nature Reserve, located in the south of Dabie Mountains and north of Yangtze River, is known as "Mount Taishan of Eastern Hubei", and the convergence zone of eastern China flora and central China flora. Unique natural and geographical environment, complex terrain and landform, and diverse mountain climate, have brought the diversity of plant species and vegetation types in Daqi Mountain Nature Reserve. The research of flora in one region is an important basis for the study of the region's plant diversity on different spatial and temporal scales<sup>[1]</sup>. In order to fully understand the vegetation type, habitat and geographic distribution in Daqi Mountain Nature Reserve, on the basis of comprehensive survey of plant system in Daqi Mountain Nature Reserve, we conduct systematic analysis of composition and geographical elements of spermatophyte flora in Daqi Mountain Nature Reserve, to provide a scientific basis for the protection, construction and management of Daqi Mountain Nature Reserve, as well as rational development and utilization of plant resources, which will be of great significance to understanding the formation and development of flora in the region and guiding the effective conservation, sustainable use and scientific management of plant resources in the region<sup>[2]</sup>.

## 1 Overview of the study area and research methods

### 1.1 Overview of the study area

**1.1.1 Natural overview.** Hubei Daqi Mountain Nature Reserve, located in the northern Tuanfeng County, Hubei Huanggang City of Hubei Province, is an offshoot of the Dabie Mountains. The east–west mountain is low, and the elevation is mostly 400–700 m (Longwangding, the highest peak with elevation of 1 040.8 m; Dujiachong, the lowest point with elevation of 107 m). The ter-

rain is high in the north and low in the south. According to the absolute height and average slope of ridge line, it can be divided into two types: low mountains and hills. The parent rock is mainly granite and gneiss. Daqi Mountain Nature Reserve has a humid subtropical continental monsoon climate, with annual average temperature of 16.8 °C. The temperature decreases with the rise in the terrain, and the average annual decline rate is 0.53 °C/100 m. It has excellent mountain climate and forest microclimate characteristics with abundant rainfall, and the average annual rainfall is about 1 262 mm. It has more precipitation in the county and is the source of two state-level large reservoirs. Daqi Mountain Nature Reserve has a total area of 1 745.9 km<sup>2</sup>, including 1 644.6 km<sup>2</sup> of forest land. The area of closed forest land is 1 439.4 km<sup>2</sup>, accounting for 87.52% of forest land; the area of pure stand is 1 098.3 km<sup>2</sup>, accounting for 76.3% of closed forest land; the area of mixed forest is 276.4 km<sup>2</sup>, accounting for 19.2% of closed forest land; the area of bamboo forest is 64.8 km<sup>2</sup>, accounting for 4.5% of closed forest land. The forest coverage is 88.8%, and the geographic coordinates are 30°48'12"–30°52'51"N, 115°04'20"–115°10'06"E. Existing vegetation is dominated by secondary forest, and the vegetation type has the typical characteristics of the transition zone from subtropical zone to warm temperate zone. The main forest communities include *Pinus massoniana*, *Cunninghamia lanceolata*, *Pinus taiwanensis*, and other coniferous forests, *Cyclobalanopsis glauca* (Thunb.) Oerst evergreen broadleaf forest, *Cyclobalanopsis glauca*, *Quercus aliena*, *Quercus variabilis* evergreen broadleaf mixed forest, *Alnus trabeculosa*, *Liquidambar formosana*, and other deciduous broadleaf forests.

**1.2 Research methods** By adopting field investigation and collecting specimens for identification, based on accumulated literature of plant resources and scientific investigation results over the years, we use the basic principle of flora geography<sup>[3–5]</sup>, to make a detailed analysis of floristic composition and geographical distribution in Daqi Mountain Nature Reserve.

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2 Results and analysis

2.1 Basic composition of flora in Daqi Mountain Nature Reserve

The findings suggest that Daqi Mountain Nature Reserve has 140 families, 534 genera and 1035 species of spermatophyte, accounting for 70% of total families, 39.41% of total genera and 18.32% of total species of spermatophyte in Hubei, respectively. There are 5 families, 8 genera and 10 species of gymnosperm, accounting for 55.56% of total families, 25.81% of total genera and 10% of total species of gymnosperm in Hubei, respectively; there are 135 families, 526 genera and 1025 species of angiosperm, accounting for 70.68% of total families, 39.73% of total genera and 18.47% of total species of angiosperm in Hubei, respectively<sup>[6-7]</sup>.

2.2 The composition and analysis of spermatophyte flora family in Daqi Mountain Nature Reserve

According to the classification of distribution pattern of spermatophyte family in China by Li Xiwen<sup>[8]</sup> who conducts a statistical analysis of family distribution type in the flora composition, Daqi Mountain Nature

Reserve has 140 families of spermatophyte, and there are five levels according to the number of species it contains. The statistical results are shown in Table 1. In the spermatophyte family composition in Daqi Mountain Nature Reserve, there are 24 families containing one species, many of which are ancient relict type, and the important symbol of primitiveness and antiquity of the flora. There are 89 families containing 2 – 10 species, widely distributed in Daqi Mountain Nature Reserve, accounting for 63.57% of total spermatophyte families in Daqi Mountain Nature Reserve (far greater than other levels of families). There are a total of 212 genera and 391 species, but the number of genus and species only accounts for 39.70% of total genera and 37.78% of total species of spermatophyte in Daqi Mountain Nature Reserve, respectively. The high percentage of this level suggests that this flora breed the phylogeny with its own characteristics and evolution of trends in a complex natural environment. At the same time, it also indicates that it plays an important role in the formation of floristic characteristics and nature, and is the core of flora in Daqi Mountain Nature Reserve.

Table 1 Statistics on spermatophyte flora family in Daqi Mountain Nature Reserve

Category	The family containing 1 species	The family containing 2 – 10 species	The family containing 11 – 20 species	The family containing 21 – 49 species	The family containing more than 50 species
Gymnosperm	1(1/1)	4(7/9)			
Angiosperm	23(23/23)	85(205/382)	17(110/241)	7(94/198)	3(94/181)
Total	24(24/24)	89(212/391)	17(110/241)	7(94/198)	3(94/181)
The share in the total families in					
Daqi Mountain Nature Reserve	17.14(4.49/2.31)	63.57(39.70/37.78)	12.14(20.60/23.29)	5.00(17.61/19.13)	2.15(17.61/17.49)
(total genera/total species) // %					

Note: The figures in the second to fourth line mean the number of families (number of genera/number of species).

2.3 The composition and analysis of spermatophyte flora genera in Daqi Mountain Nature Reserve

2.3.1 Statistics and analysis of genera. According to the survey, there are 534 genera of spermatophyte in Daqi Mountain Nature Reserve, and it can be divided into five levels based on the number of species contained in the genus. The statistical results are shown in Table 2. From the table, we can find that in the sperma-

tophyte genera composition in Daqi Mountain Nature Reserve, the gymnosperm occupies a small share; in the angiosperm, it is dominated by the genera containing 1 species and 2 – 10 species, indicating that in the flora of Daqi Mountain Nature Reserve, the vast majority of plant species are constituted by angiosperm, and there is great differentiation of species in Daqi Mountain Nature Reserve, with large biodiversity coefficient.

Table 2 Statistics on spermatophyte flora genera in Daqi Mountain Nature Reserve

Category	The genus containing 1 species	The genus containing 2 – 10 species	The genus containing 11 – 20 species	The genus containing 21 – 49 species	The genus containing more than 50 species
Gymnosperm	6	2			
Angiosperm	291	233	1	1	
Total	297	235	1	1	
The share in the total genera in Daqi Mountain Nature Reserve// %					
	55.62	44.01	0.19	0.19	

2.3.2 Geographical element analysis of genera. According to the classification principles of Wu Zhengyi<sup>[3]</sup> on the distribution type of spermatophyte in China, 534 genera of spermatophyte distributed in Daqi Mountain Nature Reserve are divided into 15 distribution types (Table 3).

(1) Genera distributed in the world. In Daqi Mountain Na-

ture Reserve, there are a total of 52 genera of plant belonging to this type of distribution area, mostly under-forest herbs. It is mainly the herbaceous and shrub genus, with few woody plant genera, and many of species are distributed in the forest edge, roadside, slopes and meadows. They hardly appear in forests, with significant secondary nature.

Common genera are: *Anemone*, *Clematis*, *Pulsatilla*, *Lepidium*, *Rorippa*, *Viola*, *Polygala*, *Stellaria*, *Rumex*, *Oxalis*, *Hypericum*, and *Rubus*.

(2) Genera distributed in tropics. There are a total of 173

genera of plant belonging to this type of distribution area, accounting for 32.4% of all genera, about 11.34% of China tropical distribution genera (1525 genera).

**Table 3 Distribution types of spermatophyte genera in Daqi Mountain Nature Reserve**

Distribution types	Number of genera	The share in total number of genera//%	Number of genera in China	The share in total number of genera in China//%
1 Distributed in the world	52	9.74	104	3.41
2 Distributed in the pan-tropics	97	18.16	362	11.85
3 Distributed in tropical Asia and tropical America	5	0.93	62	2.03
4 Distributed in the old world tropics	25	4.68	177	5.80
5 Distributed in tropical Asia to tropical Oceania	15	2.81	148	4.84
6 Distributed in tropical Asia to tropical Africa	12	2.25	149	4.88
7 Distributed in tropical Asia	19	3.56	611	20.01
8 Distributed in the north temperate zone	120	22.47	302	9.89
9 Distributed in East Asia and North America	48	8.99	124	4.06
10 Distributed in the old world temperate zone	40	7.49	164	5.37
11 Distributed in temperate Asia	7	1.31	55	1.80
12 Distributed in Mediterranean, West Asia to Central Asia	1	0.19	171	5.59
13 Distributed in Central Asia	1	0.19	69	2.26
14 Distributed in East Asia	78	14.61	299	9.79
15 Distributed uniquely in China	14	2.62	257	8.42
Total	534	100	3054	100

Distributed in the pan – tropics; There are a total of 97 genera of plant belonging to this type of distribution area, including arbor, shrubs, vines and herbs, accounting for 18.16% of total genera of flora in Daqi Mountain.

The genera belonging to this type of distribution area are: *Cocculus*, *Aristolochia*, *Begonia*, *Corchorus*, *Acalypha*, *Xylosma*, *Euphorbia*, *Glochidion*, *Phyllanthus*, *Sapium*, *Cercis*, *Crotalaria*, *Dalbergia*, *Buxus*, *Celtis*, *Ilex*, *Celastrus*, *Euonymus*, *Schoepfia*, *Ziziphus*, *Zanthoxylum*, *Diospyros*, *Symplocos*. From the families that the plants belong to, almost all are tropical or subtropical families, and there is no typical tropical family.

Distributed in tropical Asia to tropical America; There are 5 genera belonging to this type of distribution area in Daqi Mountain Nature Reserve, accounting for 0.94% of total genera of flora in Daqi Mountain.

The genera belonging to this type of distribution area are: *Litsea*, *Phoebe*, *Eurya*, *Sageretia*, *Picrasma*.

Distributed in the old world tropics; This type of distribution has stronger tropical nature and ancient and conservative elements than the pan-tropical distribution. There are 25 genera in Daqi Mountain Nature Reserve, accounting for 4.68% of total genera of spermatophyte in this region.

The genera belonging to this type of distribution area are: *Pittosporum*, *Viscum*, *Evodia*, *Alangium*, *Gynura*, *Ehretia*, *Stephania*, *Mallotus*, *Albizia*.

Distributed in tropical Asia to tropical Oceania; There are 15 genera in Daqi Mountain Nature Reserve, accounting for 2.81% of total genera in flora of Daqi Mountain.

The genera belonging to this type of distribution area are: *Cinnamomum*, *Lagerstroemia*, *Trichosanthes*, *Toona*, *Ailanthus*, *Boea*, *Zingiber*, *Cymbidium*, *Gastrodia*, *Cudrania*.

There are not many distribution type in the flora, but the role of this type in flora origination and vegetation can not be ignored, and some genera are important composition genera for evergreen forest species in the forest, such as *Cinnamomum*; some species in *Cymbidium* are important under-forest components; *Gastrodia* is an important herbal species in the region.

Distributed in tropical Asia to tropical Africa; There are 12 genera in Daqi Mountain Nature Reserve, accounting for 2.25% of total genera in flora of Daqi Mountain.

The genera belonging to this type of distribution area are: *Thladiantha*, *Firmiana*, *Glycine*, *Hedera*, *Peristrophe*, *Premna*, *Amorphophallus*, *Arthraxon*, *Miscanthus*.

Distributed in tropical Asia; This type of distribution area is one distribution type with the richest species in the Chinese flora and many oldest original ingredients. In Daqi Mountain Nature Reserve, there are 19 genera belonging to this type of distribution area, accounting for 3.56% of total genera of flora in Daqi Mountain.

The genera belonging to this type of distribution area are: *Lindera*, *Machilus*, *Pueraria*, *Lithocarpus*, *Cyclobalanopsis*, *Broussonetia*, *Pellionia*, *Boenninghausenia*, *Emmenopterys*, *Paederia*, *Pterocypsela*, *Camellia*.

(3) Genera distributed in temperate zone. In Daqi Mountain Nature Reserve, there are 309 genera of spermatophyte belonging to this type of distribution area, accounting for 357.87% of total genera of spermatophyte in Daqi Mountain.

Distributed in the north temperate zone; There are 120 genera in Daqi Mountain Nature Reserve, accounting for 22.47% of total genera of flora in Daqi Mountain. In this type of distribution, many genera are the main constituting species for evergreen broad-leaf forest, deciduous broadleaf forest, arbor, shrub and herb in Daqi Mountain Nature Reserve.

For example, *Pinus* and *Sabina* are an important part of coniferous forest in Daqi Mountain Nature Reserve, forming superior community types in some areas; *Quercus*, *Acer*, *Ulmus*, *Populus*, *Salix*, *Myrica*, *Carpinus*, *Corylus*, *Castanea*, *Castanopsis* are the constructive species or dominant species for deciduous broadleaf forests in Daqi Mountain Nature Reserve; *Rhododendron*, *Lonicera*, *Viburnum*, *Rhus*, *Elaeagnus* constitute the shrub layer of forest communities; *Valeriana*, *Anaphalis*, *Artemisia*, *Aster*, *Saussurea*, *Taraxacum*, and *Allium* are common species constituting the herb layer in the various types of vegetation in Daqi Mountain Nature Reserve.

Distributed in East Asia and North America: There are 48 genera of spermatophyte belonging to this type of distribution area, accounting for 8.99% of total genera of flora in Daqi Mountain.

The genera belonging to this type of distribution area are: *Magnolia*, *Illicium*, *Schisandra*, *Sassafras*, *Liquidambar*, *Berchemia*, *Toxicodendron*, *Nyssa*. This type is mostly of obvious temperate nature, and many genera are the representatives of ancient or primitive families, such as *Nyssa* L., *Kadsura*, *Sassafras*, *Liquidambar*; some species have become rare and endangered plants or national key protected plants.

Distributed in the old world temperate zone: There are 40 genera of spermatophyte belonging to this type of distribution area, accounting for 7.49% of total genera of flora in Daqi Mountain Nature Reserve.

The genera belonging to this type of distribution area are: *Epimedium*, *Dianthus*, *Myosoton*, *Vaccaria*, *Fagopyrum*, *Amygdalus*, *Pyracantha*, *Pyrus*, *Melilotus*, *Zelkova*, *Ligusticum*, *Oenanthe*, *Peucedanum*, *Torilis*, *Ligustrum*, *Cynanchum*, *Dipsacus*, *Carduus*, *Carpesium*, *Dendranthema*, *Inula*, *Scorzonera*, *Adenophor*. In this flora, all are herbs except a small number of shrubs or small arbor, which have the general characteristics of northern temperate flora.

Distributed in temperate Asia: There are few components falling into this category. In Daqi Mountain Nature Reserve, there are 7 genera of spermatophyte belonging to this type of distribution area, accounting for 1.31% of total genera of flora in Daqi Mountain Nature Reserve.

The genera belonging to this type of distribution area are: *Orostachys*, *Rheum*, *Armeniaca*, *Saposhnikovia*, *Cephalanoplos*, *Kalimeris*, *Trigonotis*.

Distributed in Mediterranean, West Asia to Central Asia: This type of genera is rarely distributed in Daqi Mountain Nature Reserve, and there is only 1 genus, accounting for 0.19% of total genera in flora of Daqi Mountain.

The genera belonging to this type of distribution area is *Erodium*.

Distributed in Central Asia: This distribution type is the component of arid regions in Asian inland. There is only 1 genus belonging to this type of distribution area, accounting for 0.19% of total genera of flora in Daqi Mountain Nature Reserve.

The genera belonging to this type of distribution area is

*Orychophragmus*.

Distributed in East Asia: In this type, there are many ancient types, and the features of family are obvious. There are 78 genera of spermatophyte belonging to this type of distribution area, accounting for 14.61% of total genera of flora in Daqi Mountain Nature Reserve. Many species in this type of distribution are dominant species or common species constituting various levels of forests in Daqi Mountain Nature Reserve.

The genera belonging to this type of distribution area are: *Cephalotaxus*, *Platycladus*, *Euptelea*, *Euryale*, *Nandina*, *Akebia*, *Stauntonia*, *Sinomenium*, *Houttuynia*, *Macleaya*, *Cardiandra*, *Edgeworthia*, *Actinidia*, *Chizophragma*, *Phellodendron*, *Euscahis*, *Serissa*, *Platycarya*, *Pterocarya*, *Stephanandra*, *Codonopsis*, *Kalopanax*, *Paulownia*, *Weigela*, *Atractylodes*.

Distributed uniquely in China: Most of them are autogenous and minor genus, and the components of ancient origin, original system location. In Daqi Mountain Nature Reserve, there are 14 genera belonging to this type of distribution area, accounting for 2.62% of total genera of flora in Daqi Mountain Nature Reserve.

The genera belonging to this type of distribution area are: *Ginkgo*, *Cunninghamia*, *Sargentodoxa*, *Caulophyllum*, *Eomecon*, *Poliathyrsis*, *Pteroceltis*, *Poncirus*, *Dipteronia*, *Cyclocarya*, *Tetrapanax*, *Changnienia*, *Indocalamus*.

Most of these genera are deciduous arbor or herb, reflecting the temperate characteristics of the area; some are autogenera, in a relatively primitive or isolated location in the classification system, such as *Sargentodoxa*; some in other regions have become fossils, such as *Pteroceltis Maxim.* and *Dipteronia*. These characteristics reflect the antiquity and relic of the flora in this area.

Since the late Triassic, Daqi Mountain has basically kept a warm and humid climate, and the impact of Quaternary glacial period is not big, so this region has become a refuge for many ancient plants. Therefore, Daqi Mountain flora can still preserve a large number of ancient relict plants or evolutionarily primitive or isolated families, genera, reflecting the antiquity and relic of the flora in this area.

**2.4 Flora comparison between Daqi Mountain Nature Reserve and other regions** To further understand the characteristics of flora in Daqi Mountain Nature Reserve, we choose 5 national nature reserves (Jiugong Mountain, Qizimei Mountain, Shennongjia, Taibai Mountain, Dabie Mountain) to compare with Daqi Mountain Nature Reserve in northeastern Hubei in terms of flora<sup>[9]</sup>, and the distribution type is shown in Table 4. In order to more clearly compare the flora in various regions, we choose tropical elements (R), temperate elements (T), China-specific elements (C), R/T value (tropical component/temperate component) in the flora of spermatophyte genera for comparative analysis (Table 5).

From the genera component of spermatophyte flora and especially the R/T value, the tropical elements (R) of Jiugong Mountain Nature Reserve, Dabie Mountain Nature Reserve, and Qizimei Mountain Nature Reserve, are richer than that of Daqi Mountain Nature Reserve.

tain Nature Reserve; Taibai Mountain has more temperate elements (T). Overall, there is close relationship between Daqi Mountain Nature Reserve and Dabie Mountain, and there are great similarities in the flora between the two regions. The reason is that Daqi Mountain is a branch of Dabie Mountain, located in transition zone of Eastern and Central China. Eastern and Central flora both are ancient flora, probably sharing the same source, so like the flora in Dabie Mountain, the basic composition of flora in Daqi

Mountain is most closely linked to the floristic composition in Eastern and Central China. There are also great similarities between Daqi Mountain and Shennongjia, Dabie Mountain, between Daqi Mountain and Jiugong Mountain, Qizimei Mountain, indicating that although Daqi Mountain flora is located in the interchange of Central and Eastern flora, protecting and studying the flora in this region is of important scientific and ecological value.

Table 4 Flora comparison between Daqi Mountain Nature Reserve and other regions

Number	Distribution types	Shennongjia %	Taibai Mountain %	Jiugong Mountain %	Daqi Mountain %	Dabie Mountain %	Qizimei Mountain %
1	1 Distributed in the world	7.50	10.00	8.70	9.74	9.51	8.90
2	2 Distributed in the pan-tropics	12.10	10.70	18.10	18.16	17.38	16.70
3	3 Distributed in tropical Asia and tropical America	1.40	0.60	3.20	0.94	1.31	2.40
4	4 Distributed in the old world tropics	3.40	2.30	4.90	4.68	4.43	4.10
5	5 Distributed in tropical Asia to tropical Oceania	2.90	1.70	2.70	2.81	2.95	3.40
6	6 Distributed in tropical Asia to tropical Africa	2.80	2.10	3.20	2.25	2.46	3.10
7	7 Distributed in tropical Asia	6.10	2.40	6.50	3.56	4.10	6.70
8	8 Distributed in the north temperate zone	23.80	29.40	17.40	22.66	20.49	18.9
9	9 Distributed in East Asia and North America	8.50	7.30	7.40	8.99	8.85	7.50
10	10 Distributed in the old world temperate zone	7.80	11.70	8.60	7.49	7.87	6.00
11	11 Distributed in temperate Asia	2.20	3.20	1.20	1.31	2.46	1.40
12	12 Distributed in Mediterranean, West Asia to Central Asia	0.50	1.10	1.50	0.19	0.16	1.30
13	13 Distributed in Central Asia	0.30	0.80	0.30	0.19	0.16	0.10
14	14 Distributed in East Asia	15.40	12.90	12.80	14.61	13.77	14.90
15	15 Distributed uniquely in China	5.50	3.80	3.70	2.62	4.10	4.50

Table 5 Comparison of some indicators on flora between Daqi Mountain Nature Reserve and other 5 nature reserves

Indicators	Shennongjia	Taibai Mountain	Jiugong Mountain	Daqi Mountain	Dabie Mountain	Qizimei Mountain
R	28.70%	19.80%	38.60%	32.40%	32.63%	36.40%
T	58.50%	66.40%	49.20%	55.44%	53.76%	50.10%
R/T	0.4906	0.2982	0.7846	0.5844	0.6069	0.7265
C	5.50	3.80	3.70	2.62	4.10	4.50

3 Discussions

**3.1 The spermatophyte types are rich and geographical elements are diverse and complex** Daqi Mountain Nature Reserve has a total of 140 families, 534 genera and 1035 species of spermatophyte. There are so many species within such a small area, fully demonstrating that in Daqi Mountain Nature Reserve, the species differentiation is large and diversity coefficient is big; it is one of the areas with rich flora in Hubei Province, fully showing the prominent characteristics of biodiversity in this region. In addition, the flora in this region cover all distribution types (15) of spermatophyte genera in China, and a variety of geographical elements are interwoven, also illustrating the diversity and complexity of flora components.

**3.2 The flora is of ancient origin, and relict nature** A lot of families and genera of ancient origin concentrate in Daqi Mountain Nature Reserve, and it also has some ancient relict plants. The families appearing in the early to the late Cretaceous Period include Cupressaceae, Taxodiaceae, Pinaceae, Magnoliaceae, and Eupteleaceae; the family established in the Tertiary Period is Theaceae; there are also many ancient genera, such as Pinus,

Cunninghamia, Sassafras, Dipteronia, Euptelea; the most prominent representatives of ancient relict plants include ginkgo, Euptelea and so on. In the nature reserve, there are 14 genera distributed uniquely in China, accounting for 2.62% of total genera in this region. These show the antiquity and relict characteristics of the flora in this region, and it may be one of important preservation areas of flora in the Tertiary Period in China.

**3.3 The flora is of obvious temperate nature and the tropical elements are rich** Through the analysis of distribution type of 534 spermatophyte genera in Daqi Mountain Nature Reserve, there are 309 genera of temperate nature, accounting for 57.87% of total spermatophyte genera in Daqi Mountain Nature Reserve; there are 173 genera of tropical nature, accounting for 32.4% of all genera, 11.34% of China tropical distribution genera (1 525). Among them, 120 genera are distributed in the North Temperate zone, accounting for 22.47% , ranking first; 97 genera are distributed in pan-tropics, accounting for 18.16% , ranking second; 78 genera are distributed in East Asia, accounting for 14.61% , ranking third. According to the proportion of temperate nature and tropical

Land policy. It is necessary to implement the *Notification on the Policies Relevant to Land Use in Industrialized Livestock and Husbandry Industry* (No. [2007] 220). *Five Modes of Cultivation Zone* are constructed to explore the mechanism of increasing lands for raising livestock in groups and reducing farmers' lands.

Subsidy policy. Scale cultivation is encouraged to meet the demand of disease prevention and to make life convenient to dwellers. Based on the trial in Jiangxia region in Wuhan City, different levels of subsidy standards have been set. The larger scale, the more subsidy.

Economic policy. Experiences in domestic provinces suggest that it is feasible to charge pollution fee from the raisers in densely-populated areas to fully reflect the rule of "whoever pollutes the air should resolve the environment pollution issue".

**4.5 Strengthening publication and creating favorable atmosphere of protecting ecological environment** It is suggested to publicize processing of animal excretion by stressing relevant laws and the importance of recycle use of energy, and by giving examples to help farmers to understand the importance of environment policy. Meanwhile, the government can give farmers some training about environment protection to encourage them to reduce pollution and to be responsible to themselves and to their descendents by protecting environment now.

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nature, it indicates that the flora are of obvious temperate nature, and typical characteristics of transition from subtropical zone to temperate zone; there is close relationship between the flora in this region and the flora in North Temperate Zone and East Asia.

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