Study on the Construction Strategy of Green Space in Urban Shallow Mountain Area—Taking Xishan Military Industry Community in Wulitun Area of Beijing As an Example

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Abstract: The shallow mountain area refers to the transitional area between the city and the mountainous area. The geographical environment of Beijing has created a large number of shallow mountain areas. As a potential resource for future urban space expansion, the protection and utilization of the shallow mountain area has attracted much attention in the context of rapid urban expansion. This paper discusses the green space network planning of the Wulituo area in Beijing and the green space design of the Xishan military community. From the green network construction and the green renewal of the shallow mountain community, the green space construction strategy research of the urban shallow mountain area is carried out at the meso and micro scales.

Keywords: Shallow mountain area; Green space; Mesoscale and Microscopic scale; GIS;

Introduction

“Shallow mountainous areas” appeared earlier in China, and many scholars have carried out research and discussion on this. However, due to the large differences in shallow areas in different areas, the definition and division of shallow mountain areas are still relatively vague. According to previous studies, the overall definition is as follows: “The shallow mountainous area is part of the mountainous area. It is a certain altitude and slope of the plain. The mountainous area is a plain, mountainous and mountainous with low mountains, hills, terraces, mountain plains and alluvial fans. The transition zone between the two, and the artificial development and construction of the natural habitat of the mountain, the buffer zone."（Feng, 2008）China's planning studies on shallow mountainous areas have focused on agriculture and forestry production in the early stage. As the ecological environment has been destroyed, the ecological environment in shallow mountainous areas has become more and more concerned. At the same time, in the face of the outward expansion of the city and economic development, discussions on the development and utilization of shallow mountain areas began to increase, but there is still a lack of planning research and specific practices. This paper takes the Wulituo area in Beijing as the research object. By summarizing the real problems in the Wulituo area and combing the development history of the area, this paper proposes the green space network construction strategy and the micro-scale landscape renewal strategy under the mesoscale scale of Shanshui City. Provide reference for the green space planning and design of the vast shallow mountain areas.

The Historical Origin and Realistic Dilemma of Wulituo Area

The Wulituo area is located in the Shijingshan District of Beijing, bordering the Mentougou District, west of the Western Hill of Beijing, and the Yongding River passes through the southwest. It is a bowl-shaped area surrounded by mountains and water, including shallow mountains and plains in front of the mountains. Through a summary analysis of the distribution of unincorporated villages in the history of Wulituo, it is found that in the natural geographical environment where the mountains, plains and river valleys are stepped and laterally distributed, the Wulituo area has developed from ancient times and its social production and living mode and settlements are closely related to the natural geographical environment. (Figure 1) Since the Ming Dynasty, many nobles have set up family cemeteries in Wulituo, established temples, and formed natural villages, such as Longen Temple Village and Shuangquan Temple Village, which are mainly engaged in agriculture, forestry and animal husbandry. In the plains, the Jingxi Ancient Road has passed through this, and the economic prosperity brought about it has formed a natural village such as Sanjiadian Village as a trans-shipment hub for coal and leather goods in Beijing. The sediment brought by the Yongding River formed suitable land for cultivation along the river, and gradually formed some natural villages.

Figure 1. Distribution Map of Unincorporated Villages in Wulituo Area. Diagram by the authors.

However, since the modern era, the Wulituo area has gathered industrial enterprises such as Xishan Machinery Plant and Shijingshan Thermal Power Plant. With the rise and fading of industry, many large industrial sites and structures have left the urban space. The abandoned railway has blocked the vertical traffic connection of the city, and the ecological environment of the area has been destroyed, and the development has lagged behind. Since the Ming and Qing Dynasties, the civil construction of Beijing City and the destruction of modern warfare have caused the original mountain forest vegetation in the Wulituo area to disappear basically, and the soil erosion is serious. In addition, the extensive expansion of the city continues to occupy the space originally belonging to the mountains and rivers. The predicament of the green space in the Wulituo area is:

- The forest is mottled and broken
- Water system and historical context are interrupted
- The passage from the mountain to the water is interrupted
- The conflict between mountains, water and cities

The Green Network Planning of the Integration of Mountain, Water and City in Wulituo Area

Based on the study of superior planning, three kinds of key words of green network planning in Wulituo area were extracted: ecology, countryside and green corridor; ancient roads, culture, leisure and recreation; development, transformation and comprehensive services. Based on this, it puts forward the planning objectives of restoring green shallow mountain forest land, finding source and waterfront context, ensuring ecological security, and connecting life and nature. The green space of Wulituo area is positioned as a transition space of landscape city integrating natural ecological conservation, original protection of rural areas, sightseeing of landscape scenery, historical and cultural inheritance, and urban life service, with shallow mountain forest land and yongding river water vein as the background, ecological security as the basis, and life connection as the pursuit.

Construction Strategy of Green Network in Wulituo Area

The construction of the green network in Wulituo area firstly analyzes the ecological security pattern of the region and the needs of urban residents' life recreation, from hydrological safety, geological safety, bio-safety, and urban parks, mountain recreation, and slow-moving demand. Through the use of GIS software and analytic hierarchy process. By constructing an ecological security pattern and a living recreation network, the initial scope of the urban green space is obtained. In addition, combined with the functional layout of other urban land, functional planning and positioning of each green space was carried out to achieve the design goal of building a green space network that meets the needs of ecological security and living recreation.

Ecological Security Pattern Construction

Through the use of GIS analysis, the basic data and literature data are used to construct the hydrological safety pattern, geological disaster buffer safety pattern and comprehensive bio-safety pattern in Wulituo area. These three patterns correspond to the water conservation area, the mountain key conservation area, the substrate, and the plaque. Blocks and corridors. A comprehensive analysis of the three patterns can provide an integrated ecological security pattern, that is, a green space based on ecological security. (Figure 2)

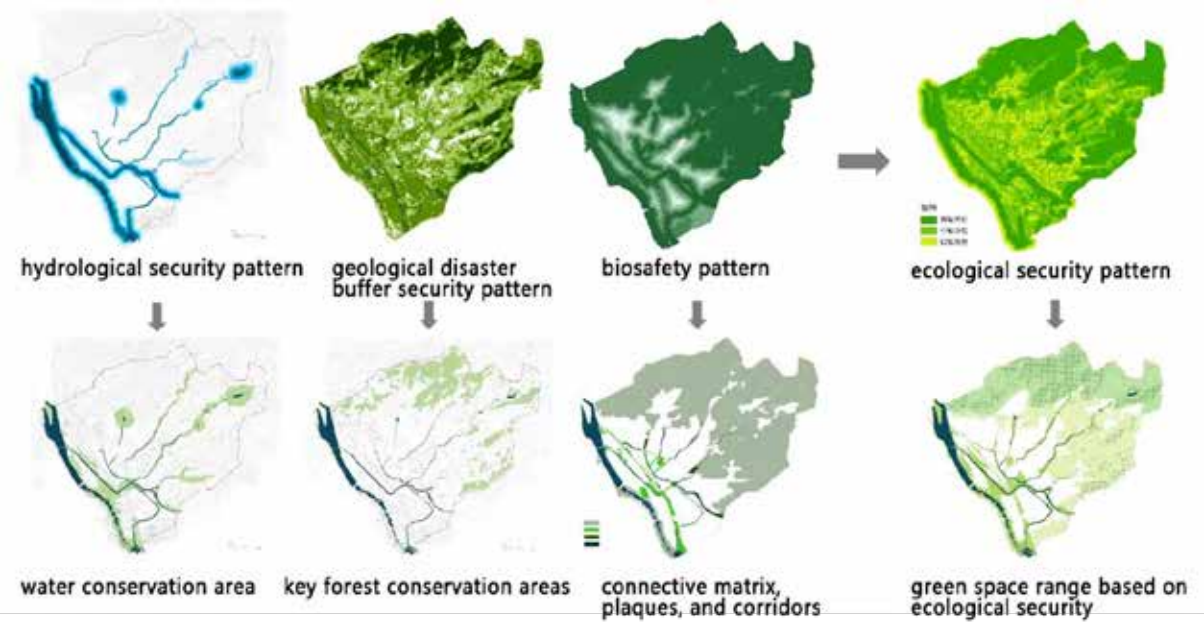

Figure 2. Ecological Security Pattern Construction Process. Diagram by Hu, E., Sun, Y., Huang, T.

Hydrological Security Pattern

Hydrology is closely related to human production and life, habitats of animals and plants, and is an important reference for flood control, drought relief, water resources management and related infrastructure construction. The shallow mountainous area is at the foot of the mountain. The mountain rainwater runoff flows from the upper part of the mountain. When it supplements the water source for the mountain river, it also forms a flash flood hazard in the rainy season, as well as soil erosion and water pollution. According to the hydrological process associated with green space, the hydrological security pattern is divided into three aspects: water conservation, rainwater defense and water quality protection. Through GIS analysis, the water source safety pattern, rain flood inundation area and water quality protection pattern were obtained, and they were superimposed to obtain a hydrological safety pattern.

Geological Disaster Buffer Security Pattern

As a transitional zone between mountains and plains, shallow mountainous areas are geological disaster-prone areas, and green space can be an important area for buffering geological disasters. Therefore, to construct a geological disaster buffer security pattern, on the one hand, it can prohibit urban construction by defining geological disaster sensitive areas as green space, and on the other hand, it can increase green space in areas with high geological disasters, thereby preventing and delaying the occurrence of geological disasters. Through the analysis of geological hazard in GIS, several factors (slope, land type, vegetation coverage) that affect the geological disaster buffer can be inlaid and reclassified according to the empirical weights, and the regional geological disaster buffer pattern is obtained.

Biosafety Pattern

The green space is an ideal habitat for a large number of living things. The shallow mountainous area is located in the interlaced zone between the mountainous area and the plain. The species richness is high, but it is also a region that is greatly disturbed by humans. The fragmentation and homogenization of the green space is unfavorable for the safety of the species habitat. Therefore, it is necessary to construct a biosafety pattern. By referring to the literature, three representative birds, mammals and amphibians in the Wulituo area were selected as indicator species. Based on their living habits, the impact of species and other factors on species movement

was scored. Then, based on the island biogeography theory, the biological source area is selected, the landscape resistance surface is established, and the spatial analysis is carried out by GIS to identify the buffer zone, the source connection, the radiation channel and the strategic point, and the safety patterns of the three species are superimposed to construct a comprehensive biosafety security pattern. Different levels of safety were visualized and graded to form a comprehensive assessment of habitat suitability of the three species. Then it is superimposed with the analysis of vegetation coverage to obtain a comprehensive biosafety pattern.

Life Recreation Network Construction

The urban green space is responsible for important life recreation functions. By defining the urban residents' demand for urban park green space in Wulituo area, the park system is constructed, the mountain forest area with recreation value is demarcated, and the chronic demand integration slow-moving system of the population in the area is analyzed, and then the construction of the living recreation network is completed. (Figure 3)

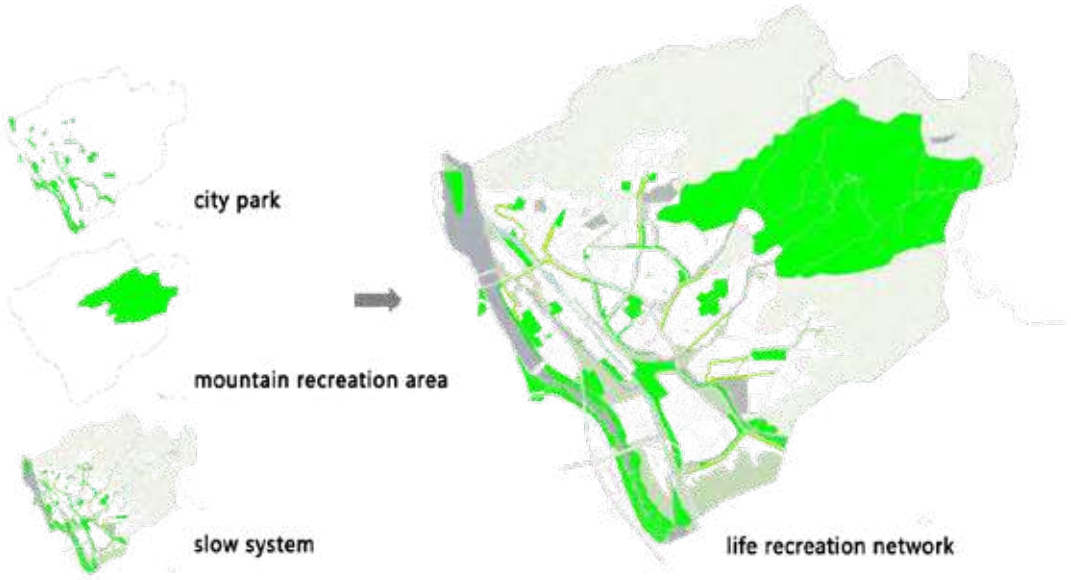

Figure 3. Life Recreation Network Construction Process. Diagram by Zhao, X. and Fan, B.

City Park

According to the Ministry of Housing and Urban-Rural Development, the park service radius of 500m should cover all residential areas. The coverage of the park green space with an area of more than 5,000 square meters in the Wulituo area has not yet reached this standard, and it is necessary to increase the urban park in the blank area. Through the renewal of urban wasteland and the renovation of existing green space, covered the blank area by the park service, new urban parks will be planned according to the current conditions of the plot and the principle of uniformity. The urban park's 500m service radius covers all urban residential areas, and meets the urban park needs of residents in the Wulituo area in terms of spatial layout.

Mountain Recreation Area

The demarcation of the mountain recreation space is mainly based on the analysis and evaluation results of the ecological sensitivity assessment and the mountain recreation demand analysis (mountain landscape value and humanistic features). Areas with high ecological sensitivity are not suitable for recreational activities, and areas with high demand for mountain recreation should be included in the mountain recreation space for demand. The range of mountain recreation areas is comprehensively defined by the ridge line and the road.

Slow System

The construction of the slow-moving system begins with the selection of various types of slow-moving needs. By crawling out the commercial hotspots in the area with big data in the Internet, it combines residential areas, urban parks, cultural relics, public transportation stations, and riverside landscape nodes. These points are connected and selected, and the results of urban greenway selection are obtained after comprehensive superposition and partial adjustment. The mountainous area is rich in mountainous recreation resources, and the construction of mountain forest recreation trails is indispensable. According to the walking trajectory of the hiker recorded from the track record app, the potential route of the mountain recreation and the viewpoints along the line are obtained. Combining the existing mountain roads, we can obtain the results of the selection of our mountain trails by retaining, adding, connecting, and extending these routes.

Construction of Green Network in Wulituo Area

By superimposing the green space based on ecological security and life recreation, combined with the current satellite imagery, the planned green space is obtained. Considering the natural ecological factors of green space and the surrounding areas of commercial, residential and educational land, the dominant and composite functions of green space are determined. Eventually, a green space network linking mountains, rivers and cities will be formed.

Green Landscape Renewal of Xishan Military Industry Community in Wulituo Area

Xishan Military Industry Community, located in the hinterland of Wulituo, mainly includes the factory area and family area of Beijing Xishan Machinery Factory, one of the former “Eight Factory in Western of Beijing”. In recent years, production in the factory has stagnated, community infrastructure has been slow to update, and the needs of residents' living and leisure have not been met. At the same time, the community located on the Tiantai Mountain is rich in mountain woodland resources, which is a valuable landscape resource for the city. Combined with the positioning of the green space in the green space network planning, the micro-scale design strategy continues the principle of meeting the ecological and recreational functions of the green space in the shallow mountainous area. At the same time, in close connection with the actual situation of the site, the design method of landscape garden was used to respond to the problem of urban renewal. (Figure 4)

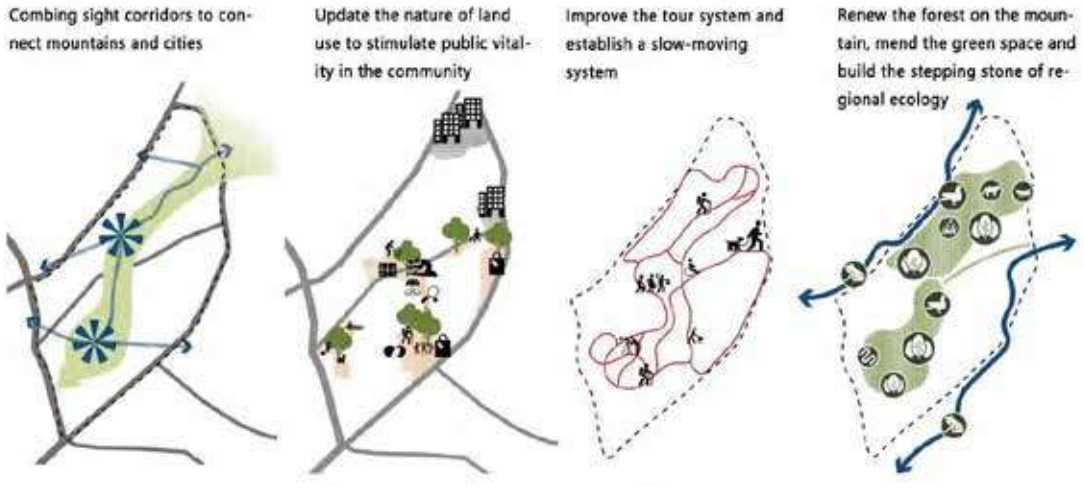

Figure 4. Design Strategy. Diagram by the authors.

Combing Sight Corridors to Connect Mountains and Cities

By dismantling the existing shantytowns and shops to expose the mountain and opening up the sight window and sight corridor for the tourists at the entrance of the park, the different styles of the mountain parks are

shaped, and the demand for “seeing” from the urban interface to the mountain park is basically realized. By using plants to strengthen the ups and downs of mountain parks, the beautiful urban landscape is constructed. Various viewing platforms have been set up at different altitudes using different platforms. The landscape space along the way of the mountaineering makes up the landscape sequence with the open space under the mountain, the enclosed space on the mountainside and the open space on the top of the mountain.

Update the Nature of Land Use to Stimulate Public Vitality in the Community

Within the design scope, there are large-scale shantytowns, low-end businesses, and messy wasteland. After identification and evaluation, three shanty towns and low-end businesses were demolished. In combination with the overall lack of commerce in the Wulituo area and the potential commercial needs of large residential areas in the surrounding areas, large commercial centers and commercial pedestrian streets will be established to stimulate regional vitality. Located in the center of the military community's residential area, there is a community of medical service stations, community pension centers, vegetable markets, supermarkets and other community service facilities. The functions are preserved and integrated in place to form a higher quality community service center. The launched land is used as a community sports venue to build a vitality center that meets the needs of residents. The Xishan Machinery Factory site, which has basically stopped production, has been renovated and remodeled. In view of the presence of artist studios in the factory area, the factory area has been transformed into an art district, attracting artists and design groups to come here. (Figure 5)

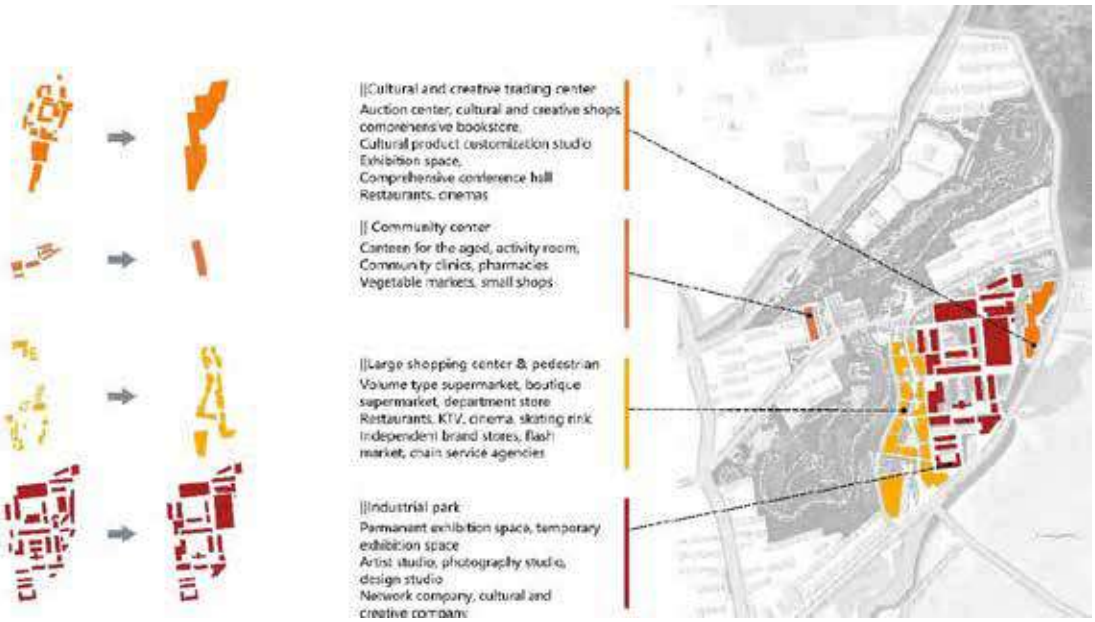

Figure 5. Land Use Update. Diagram by the authors.

Improve the Tour System and Establish a Slow-moving System

Connect the urban slow-moving roads within the designed range, suspend the slow-moving system of urban and mountainous and water systems, and form a landscape tour system consisting of mountain park roads, urban road walkways, community slow-moving systems and outdoor activity venues, and The slow-moving system in the green space network of the Wulituo area is docked. The terrain in the shallow mountain area is richly varied. By properly handling the height difference, setting up the site and carrying out special activities, it can increase the interest of slowness while satisfying the demand for traffic. (Figure 6)

Figure 6. Landscape Slow System and Event Planning. Diagram by the authors.

Renew the forest on the Mountain, Mend the Green Space and Build the Stepping Stone of Regional Ecology

The forests in the mountains of Wulituo area are dominated by the pure forests of *Arboreal cypress* and *Pinus tabulaeus*, which are basically the products of the artificial afforestation movement in the 1950s and 1960s. For many years, the agricultural forest management mode has been adopted to form a single-layer forest structure, and problems such as slow growth of stands, decline of soil fertility, decrease of landscape recreation function, and sharp decrease of biodiversity have emerged. (Ning *et al.* 2009) The strategy is mainly to transform the artificial forest into natural one. By hygienic cutting, removing interfering trees, adjusting the competition

between trees and the utilization of resources to promote the growth and development of outstanding individuals in the main forest layer. At the same time, through the protection and promotion of natural regeneration under the forest, and artificial replanting of the local climax community tree species -- *Quercus variabilis* -- in areas with weak natural regeneration ability, the forest recovery and self-development mechanism can be promoted. (Figure 7)

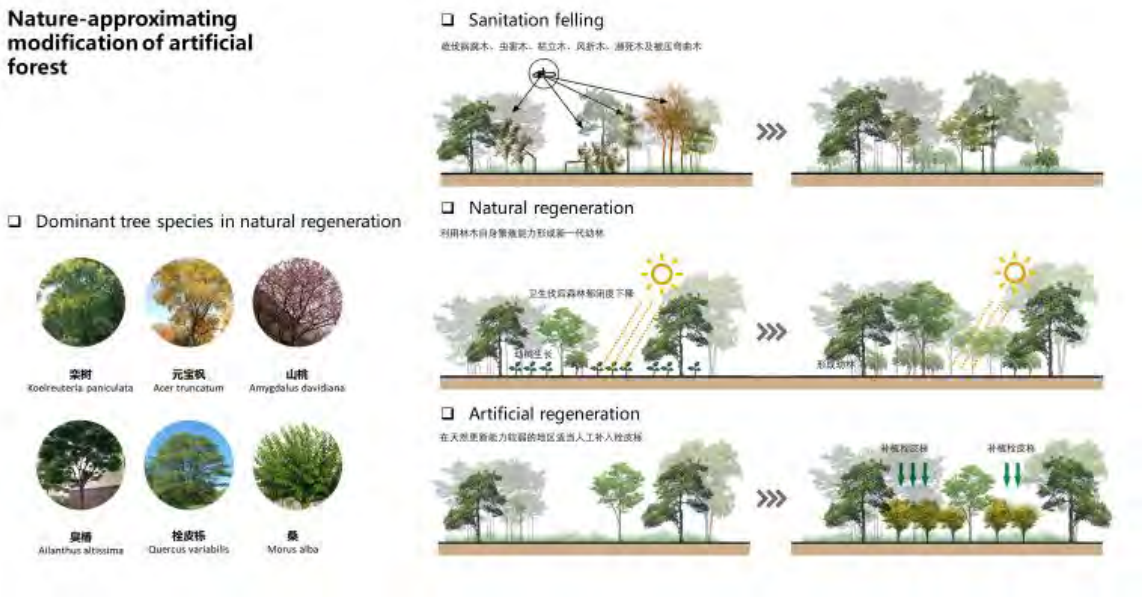

Figure 7. Nature-approximating Modification of Artificial Forest. Diagram by the authors.

The "stepping stone" refers to a small plaque habitat that can temporarily inhabit (stepping) when the animal migrates and spreads. Its presence is conducive to increasing the connectivity of the landscape, thereby increasing the chances of successful species movement and diffusion. (Hua, Li and Gao, 2005(04):30-31) The Paochang Mountain in the Xishan Military Industry Community is embedded in the city as the remaining vein of the Tiantai Mountain. Due to the good vegetation, a large number of birds are inhabited here, so the Paochang Mountain has become an ecological stepping stone. potential. In order to improve the richness of the habitat of the Paochang Mountain, the habit characteristics of the birds in Beijing woodland were considered in the selection of plant species, and the plant community was designed to meet the habitat preference of birds distributed at different heights of the plant community and provide food sources.

Renewal Results

Through the renewal of the green landscape of the Xishan Military Industry Community, it has become a region where mountains and waters are integrated, which has inspired the vitality of the Xishan military community and surrounding areas. The ecological restoration and development of the Paochang Mountain has created a new important landscape node for the Wulituo area, enriching the urban landscape and improving the construction of the urban ecological corridor. Through the reuse of stock space such as shantytowns, multiple urban functions are implanted in these spaces to provide the possibility of activating the site. In the micro-scale, the strategic principle of the meso-planning is continued, and landscape architecture methods were used to respond to the site problem. (Figure 8)

Figure 8. Updated Plan of Xishan Military Industry Community. Diagram by the authors.

Conclusions

The protection and development of green space in shallow mountainous areas is an important way to establish a balance between urban development and environmental protection. In this paper, the construction of green space at the two levels of mesoscopic network and micro-design in Wulituo district of Beijing is taken as the entry point, hoping to provide reference for rational utilization and protection of green space in shallow mountainous areas of Beijing and other cities in the world.

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