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Original Research Paper

Study on Urban Ecological Security Park Planning Strategy and Type Based on Extenics Method

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ABSTRACT

Ecological safety park planning (ESPP) becomes gradually a new research trend in urban public safe planning field. Its theories and methods are still in the initial stage. It is universal problem for urban park planning contradiction, which needs to be dealt with all kinds of ecological environmental issues, such as the relationship between park environment and human behaviour psychology. Ecological park and landscape need to be resolved, otherwise it will affect the harmonious development of city and living. Extenics is an original subject to solve contradiction and can make up for the shortage problem solving contradiction. Therefore, it is realistic and urgency to researching urban ecological park planning strategy based on extension methods. This paper firstly discussed urban ecological park concept and pointed out that conventional design theory used to solve the contradictory problem is insufficient. This provides a new solution method for ESPP scheme and preparation.

INTRODUCTION

With the deepening development of the urban sustenance, urban park planning pay more attention to its own ecosystem, and has become one of key and difficult points of the urban public safety planning research. Due to the complicated contradiction problem, related factors affecting the theory planners do not know that how to comb problem fundamentally, make the planning appeared deviation, so it urgently need to establish a suitable theoretical method to solve such problems. Extenics is the rule and method of studying the possibility of things expand and innovation with formalized model, and is the new subject to solve contradictory issues (Cai 2003).

OVERVIEW

Concepts of ESPP: ESPP is located in the city or suburb area, by retaining, imitate or repair regional natural habitat to construct main environment in order to protect local ecological system of regionalism, diversity and the ability of self-succession, and improve the urban public security system as the main target, to ecological security or technology as the theme, is a kind of public garden, which provides harmonious sightseeing, recreation, practice, disaster prevention and avoiding disaster activities with the natural ecological process (Deng 2007).

Contradictory problem model of ESPP: In Extenics, contradictory issue is the problem which the people cannot achieve the goal under the existing conditions (Yang & Cai 2003). ESPP faces two main categories *P:* incompatible problem and opposite problems. Incompatible problems are kinds of general contradiction problems between subjective desire and objective conditions. It is the key point of ESPP solution, such as the contradiction between ecological protection and conditions. Opposite problem are kinds of special contradiction problems ,which can not achieve at the same time under the condition of the same two or more target (Yang & Cai 2003). It is the difficulty of ESPP solution, such as the contradiction problem between ecological restoration and people's viewing. ESPP issues *P* is consist of planning goals *G* and current conditions *L* (Sun & Dong 2012).

Incompatible problems *P* model is:

$$P=G\uparrow L \quad ...(1)$$

Opposite problems *P* model is:

$$P=(G1 \wedge G2) \uparrow L \quad ...(2)$$

Where *P* is a problem about ecological security; *G* is goal; *L* is limit.

By defining, analysing, transforming goals *G* and conditions *L*, the incompatibility problems translate into the compatible problems, and contradiction problem translate into a coexistence problem, which provides the tools to solve the contradictions problem of city ESPP for people (Zhao & Su 2010).

Extenics method to solve the contradiction problem: Base-element theory is one of the Extenics pillar theory, which is

basic unit with formal language to describe the problem, is the logic cells of extenics, includes matter-element $M=(O_m, c_m, v_m)$, affair-element $A=(O_a, c_a, v_a)$, relationship-element $R(O_r, v_r1, v_r2,\ldots)$. Extenics method is one basic method to solve contradictions with extenics (Yang & Cai 2003). Base-element was written as: $B=(O, C, V)$. Base-element can have a more comprehensive understanding of the relationship between things, offers a feasible tool to solve the formalization of contradiction problem (Sun 2010).

Goal of ESPP: The main target of its planning is ecological protection, but also includes goals of ecological security, etc. To protect the ecological environment it needs to build a regional characteristics park ecosystem with a reasonable ecological structure; goals to create a beautiful landscape should be combined with park ecosystem material construction; to construct a landscape spaces with ecological aesthetics and cultural significance with goal to provide appropriate arrangement.

PLANNING TYPE

Protective ESPP: It refers to city ecological security park that the original natural ecological environment of the site is good or have important ecological significance, which realize its function mainly by protecting and using the original ecological system protection (Yang & Cai 2003). Its focus is to protect the ecological diversity, the use function of the park, and landscape design should give priority to ecological protection. Such as the Shenzhen mangrove seashore ecology safety park builds the buffer area for mangrove nature reserve. Shenzhen lotus park focuses on ecological security protection of excellent natural function to improve ecological environment. Fig. 1 shows these planning processes and simulation is expressed.

1. To list problem model of park planning: $P = G \times L$

   G = (base, ecofunction, systematicness + continuity),
   L = (base, ecofunction, good)

2. Disperse analysis on the existing conditions:

$$L\dashv\begin{cases}\begin{bmatrix}Connect, & control\ object, & park\\ & way & green\ corridor\end{bmatrix}\\ \begin{bmatrix}Cultivate, & controlobj\,ect, & biodiversi\,ty\\ & means, & eco-techno\log y\end{bmatrix}\\ \begin{bmatrix}Use, & control\ object, & eco-techno\log y\\ & means, & water\ cycle\oplus solar\ energy\end{bmatrix}\end{cases}$$

3. Get planning strategies: According to the goal "living museum", landscape design combined with ecological protection and ecological science education; secondly, in city scale green landscape corridors interconnected with other park, to strengthen the continuity and systematicness of urban ecological security space; finally, the strategies are to take ecological technology such as the water cycle and solar energy utilization (Deng 2007).

Repair type ESPP: It refers to the city ecological security park with that the original natural ecological environment of the site have serious pollution or destruction, which achieve its function mainly through the systematic ecological means to repair damaged ecological system (Deng 2007). Shanghai Laogang Landfill eco-park, which is Shanghai's largest dump formerly, with stinking landfill field, black river, everywhere can see the phenomenon of environmental pollution. The planning builds ecological leisure park in the site by covered overburden, cultivating suitable microbial and plant community. The process simulations are expressed as:

1. To list problem model of planning: $P=G\uparrow L$

   G = (Site, use function, ecological safety park)

   L = (Site, use function, landfill)

2. Rational analysis on conditions management:

   (Landfill, c,v) $\Rightarrow$ (Soil, c,v) $\Rightarrow$

   (Covered overburden, c, v) $\Rightarrow$

$$\begin{cases}\begin{bmatrix}Cultivate, & controlobject, & microorganism\\ & means, & ecotechique\end{bmatrix}\\ \begin{bmatrix}Cultivate, & controlobject, & phytocoenosium\\ & means, & ecotechnique\end{bmatrix}\end{cases}$$

To get planning strategies forming a implication gallery which the condition of wasteyard translates into ecological safety park, through a series of measures. 40% humus soil has improvement of saline land; 30% non-biodegradable plastic, rubber, etc. carry on recycling and reusing; garbage of the remaining 30% bricks, etc. is used to backfill soil, and repair the original site.

Improvement type ESPP: It refers to the city ecological security park with that the original natural ecological environment of the site is ordinary, neither serious pollution destroyed, nor special habitat protected, mainly by improving the habitat, build regionalism diversity, and the self-succession ability to achieve its function, which is common in new park (Deng 2007) such as Japan Chiba prefecture ecological security park, combined with the museum, local characteristics of the vegetation types and micro habitat construction, improve the ecological environment and biodiversity in the centre of the city. Kunshan city ecological forest park located in the west of the city centre, covering an area of 188 hm^2, was formerly agricultural land, including a little industry and public land, relatively flat

terrain, one-third of base was the water area and there were the high tension line on the east of base (Deng 2007), which have incompatibility to create goal of the national ecological forest park. Simulations are expressed as Fig. 2

1. To list key problem model of contradictory issues:

P=G↑L

$$G\Rightarrow\begin{cases}G_1=(Water\ function\ full water area system)\Rightarrow\begin{cases}G_{11}=(Pond\ function\ lake)\\G_{12}=(River\text{branch}\ function\ river w\end{cases}\\G_2=(Forestland function\ full forest system)\Rightarrow\begin{cases}G_{21}=(Vegetation type\ native tree)\\\dots\end{cases}\\G_3=(Landform function\ high\text{-}low change)\Rightarrow\{\dots\\\dots\end{cases}$$

$$L\Rightarrow\begin{cases}L_1=(Surface,\ function,\ nothing)\\L_2=(forestland,\ function,\ no\ system)\\L_3=(Landform,\ function,\ \text{monotone})\end{cases}$$

2. Disperse analysis on water: to comb ponds and small river fork.

$$L_1\dashv\begin{cases}(water\ surface,\ shape,\ aesthetics)\\(water\ surface,\ shape,\ freestyle)\\(water\ surface,\ depth,\ keeping\ status)\\(water\ surface,\ depth,\ pleasure-boat)\\(water\ surface,\ compound\ \text{mode},\text{interconnection})\\(water\ surface,\ compound\ \text{mode},\ keeping\ status)\end{cases}$$

3. The surface conditions for convergence

$$\vdash\begin{cases}(water\ surface,\ shape,\ freestyle)\\(water\ surface,\ depth,\ pleasure-boat)\\(water\ surface,\ compound\ \text{mode},\ connected\ \text{system})\end{cases}$$

To meet the requirements of target G_1, form complete and smooth waters systems throughout the dominated.

4. Disperse analysis on forest land L_2 vegetation.

$$L_2\dashv\begin{cases}(Forest\ land,\text{variety},\ local\ tree)\\(Forest\ land,\text{variety},\ lawn)\\(Forest\ land,\ way,\ scattered\ planting)\\(Forest\ land,\ way,\ flxible)\end{cases}$$

5. The surface conditions for convergence:

$$\vdash\begin{cases}(Forest\ land,\ wariety,\ local\ tree)\\(Forest\ land,\ way,\ flexible)\end{cases}$$

In accordance with factors of the requirements of planning goals and cost of construction, solutions are convergent. Lay out common native trees in the south of the Yangtze River including of *Metasequoia*, Alamo, etc. According to characteristics of different partitions, solutions choose to grow, meet the requirements of target G_2, and form system of combining with the characteristics of forest land soil and terrain.

6. Disperse analysis on terrain L2: Earth volume balance in the site.

$$L_3\dashv\begin{cases}(Terrain,\ earth\ volume,\ balance)\\(Terrain,\ earth\ volume,\ outward)\\(Terrain,\ topography,\ flat)\\(Terrain,\ topography,\ high-low\ conversion)\end{cases}$$

7. The terrain L_3 for convergence:

$$\vdash\begin{cases}(Terrain,\ earth\ volume,\ balance)\\(Terrain,\ topography,\ high-low\ conversion)\end{cases}$$

8. Get planning strategies: Balance earth volume in the park, improve the flat status quo of garden topography, meets the demand of target G_3, form high-low and strewn at random topography.

PLANNING STRATEGIES

1. To protect the healthy topsoil. The topsoil is located in top 10~25 cm soil layer of natural soil, which contains rich nutrient and microorganism, and supports more than 70% physiological activity of plant roots. In ecosystem, animals must depend on green plants to create chemical energy, all the plants depend on the topsoil. Topsoil is the mother of life, naturally forming 1 cm topsoil needs 100 to 400 year, protect healthy overburden should be taken into account in the planning.

$$G=(O,\ c,\ v)\Rightarrow\begin{cases}G_1=(Keep,\ c,\ topsoil)\\G_2=(Lighten,\ c,\ topsoil\ \text{interspace})\\G_3=(\text{Protect},\ c,\ natural\ soil)\end{cases}$$

Retaining the topsoil, protecting natural soil, and reducing the topsoil gap are lower goal to protect topsoil, through their implementation, achieve goals to protect topsoil.

2. Emphasis on the protection and the construction of the wetland system: Wetland plays an important role in climate regulation, water conservation, maintaining biodiversity and ecological balance. The implication analysis is:

$$G=(O,\ c,\ v)\Rightarrow\begin{cases}G_1=(Control,\ control\ object,\ water\ and\ soil\ loss)\\G_2=(Limit,\ control\ object,\ leisure\ activity)\\G_3=(\text{Protect},\ control\ object,\ wetland\ nature\ structure)\end{cases}$$

Given strategy for protecting wetland system, the function and way of the wetland have implication analysis:

Fig. 1: Shenzhen mangrove seashore ecology safety park [7]

Fig. 2: Kunshan ecological forest park [7].

$$G = (\text{Wetland, function}, v) = (O, c, v)$$

$$G \Rightarrow \begin{cases} G_1 = (O,\ c,\ \text{protection zone}) \Rightarrow \begin{cases} G_{11} = (\text{Control control object water and soil loss}) \\ G_{12} = (\text{Limit control object leisure activity}) \\ G_{13} = (\text{Protect control object wetland nature structure}) \end{cases} \\ G_2 = (O,\ c,\ \text{ecological facilities}) \Rightarrow \begin{cases} G_{21} = (\text{Eco-facility way};\ \text{nature wetland}) \\ G_{22} = (\text{Eco-facility way};\ \text{artificial wetland assisted}) \end{cases} \\ G_3 = (O,\ c,\ \text{science and education area}) \Rightarrow \{\ldots \\ G_4 = (O,\ c,\ \text{wetland scenic spot}) \Rightarrow \begin{cases} G_{41} = (\text{Wetland landscape function ecological function}) \\ G_{42} = (\text{Wetland landscape function landscape function}) \end{cases} \end{cases}$$

By the above analysis, ESPP strategy can adopt the following methods:

Wetlands preserve as protection zone, in order to protect the structure, and become the habitats. By controlling upstream wetland soil and water loss, restricting wetland construction and recreational activities, of wetland natural structure obtain better protection.

Wetlands are transformed into ecological facilities, on the basis of natural wetlands, supplemented by artificial wetland, to form an efficient water storage and purification system, space layout planning processes are organized according to the wetland ecological functions.

Wetland, as a place for popular science education, provide a better place with an understanding its structure and functions, and display composite natural ecological process and ecological function.

CONCLUSIONS

On the basis of the definition of ecological safety park, paper discusses three types of urban ESPP. Based on extension methods, it transform and analyse the existing park case, from solving the contradictory, through the establishment of problem model, extension analyses and transformation method, It generates a better planning strategy, which provides a formalized description and expression tool for urban ecological security planning process, provides a new solution, for the planning design and promotes the process of the planning legalization and standardization.

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