Ecological Rehabilitation of Industrial vacant land in Three Gorges Project

1 Background

The large-scale water conservancy project is a symbol of human industrial civilization. The world-renowned Three Gorges Project is located in the juncture of upper and middle stream of the Yangtze River which is the largest dam ever in the history. It is a complicated systematic engineering integrating flood control, power generation, navigation and water supply. The project will be completed in 2009. The construction of the Three Gorges Dam is a strategic solution of controlling and developing the Yangtze River. It also plays a critical part in boosting the sustainable development of Yangtze River continually. The construction stage will turn to the management and operation stage while the dam is completely built. However, the construction of the dam also brought about certain changes of the topography as well as the local climate, the soil condition and the native vegetation on the site. In addition, a large quantity of engineering damage coursed by construction has been produced. Industrial vacant land has taken shape in the same time. All these give rise to certain impact to the ecological environment of the Three Gorges Water Conservancy Area.

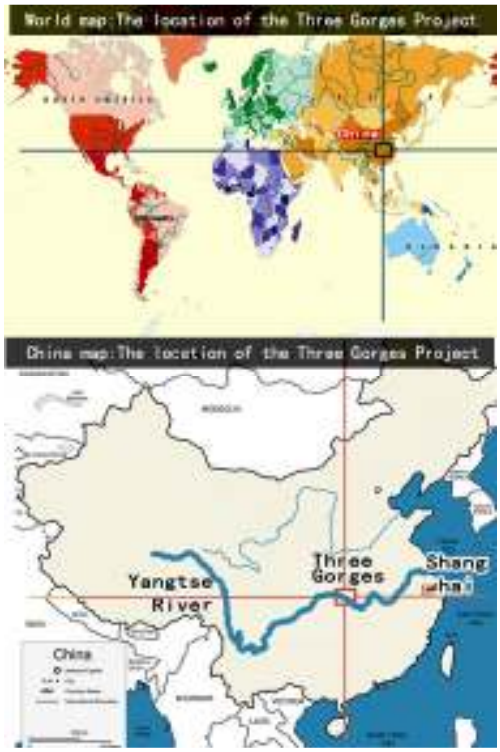

Figure 1 location maps (Personal Achieve)

One objective of low-carbon city is 'to keep the energy consumption and CO2 emission at a relatively low level under rapid economic development of a city' (Xin & Zhang, 2008, 98-102). So far, world practices of building low carbon cities mainly include (Tatiana, 2007, 91-92): developing new clean technologies and clean energies; pushing forward sustainable design and buildings; establishing high-efficient traffic and transportation planning; advocating

resources recycling and green consumption. In the field of land utilization, low carbon city is mainly shown in efficient and cycled utilization of urban land.

Under the direction of sustainable development, China has drawn a deeper understanding of harmony between intensive society, human activities and ecological environment with prudent attitude in urban development. The potential value of those vacant industrial lands has been gradually realized by people. Therefore, how to make intensive use of urban land resources and recycled use of these building project facilities with strategies of ecological rehabilitation of the sites and discarded structures through proper measures is an important issue for the Three Gorges Project. The significance is to cope with the environmental crisis of global warming and build a low carbon city. In this paper, the site of Three Gorges Project is taken as an example in the discussion of the principle and methodology for the ecological rehabilitation and regeneration of vacant industrial land.

2 General Methods for Ecological Rehabilitation of Vacant industrial land

2.1 Relative Concepts

'Industrial vacant land' normally refers to those lands used for industrial production or for traffic, transportation or warehousing in connection therewith and now discarded, e.g. discarded mines, quarries, factories, railway terminals, jetties or industrial waste dump yards. These industrial facilities used to play an important role in the urban development history. It usually has witnessed the evolvement of a city or a region.

'Ecological rehabilitation' generally means the restoration of the original ecological functions of the ecosystem in terms of water and soil retention, microclimate regulation as well as bio-diversity maintenance. These economic functions such as development and utilization by virtue of the self-rehabilitation of nature are normally with the help of appropriate human interference (Yang & Meng，2004，7-9). The deep meaning of 'Ecological rehabilitation' is far more than the planting and greening simply intended for preventing water and soil erosion or improving the visual effect, but rather an attempt to reconstruct, direct or accelerate the natural evolvement to put the damaged ecosystem back to positive cycle over a period of rehabilitation.

2.2 Existing Methods for ecological rehabilitation of industrial vacant land

Industrial vacant land takes shape from changes in the urban land value arising out of the

declination of industrial zones and the adjustment of urban industrial structure, or possibly might be a periodical product from mass project constructions. An example is the Rust Belt in the US, which refers to the heavy industrial urban zones in Auckland and Los Angeles where some large iron and steel works were closed down, deserted or disused as a result of the industrial transformation in the cities. Ecological rehabilitation of Industrial vacant lands generally addressed from three aspects:

- Rehabilitation of Vacant industrial land

The process of rehabilitation of industrial vacant land includes three levels.

Species: Species are the foundation for the ecological rehabilitation on the site. The damaged place could be rehabilitated by planting both native species and new species;

Group of species: It encourages self-sustainability of species as well as diversity of biological groups. It helps to create habitat context upon the basis of planting the native species.

Landscape layout: The target of landscape layout is a higher level of ecological rehabilitation. The designed landscape not only brings in native species but also encourages development of diversified biological populations which eventually creates good measures, landscape and visual effect.

- Disposal of industrial discarded buildings and structures

This part mainly includes three kinds of ways:

Complete conservation: The facilities left on the site are unchanged, which includes buildings, equipment facilities, road systems and functional areas of the industrial facilities.

Partial conservation: Segments of the discarded industrial landscapes are left to become landmarks of the site. Conserved segments may be typical industrial landscapes representing a factory properties or industrial buildings of historic value or old buildings of good quality.

Structure conservation: Part of the buildings or structures are conserved such as walls, foundations, frameworks or other components from which the original industrial landscapes can remind the sense of a place and local memories (Li Hongyuan, 2005, 15-17)

- Reuse of waste materials

Material recycling is one of the ecological principles. Waste materials on industrial vacant land are a sort of resources. There are two ways to enable recycling of these materials.

One strategy is using waste materials locally as needed. It saves time and energy to turn industrial waste materials into unique materials for landscape design.

Another strategy is reusing waste materials after primary processing. The reformed material may not be able to recognized, for instance, tiles from removed buildings may be used as filling materials of the site.

After reasonable ecological rehabilitation, industrial vacant land may be developed into land of many purposes while conserved industrial buildings and structures may also contribute new cultural connotation to new functions. Successful redevelopment may turn discarded land into retailing commercial areas, residential areas, office areas, pollution-free industrial areas, parks, plazas or exhibition halls, with the purpose to use the land in regenerative cycles and thereby enable sustainable utilization of urban land. In this way, ecological rehabilitation represents a sustainable development ideology of comprehensive effect. It not only improves the environment of areas already developed and protects environment of areas but also develop to achieve a positive cycle in the compound system of ecology, economy and society. Therefore, under the guideline of ecological reconstruction, probing for the cultural connotation, social value and ecological value of the place and utilizing existing resources, Industrial vacant lands shall be transformed into urban resources and active momentum pushing the city toward to the further development (Shen & Zhao, 2006, 28-30).

3 Existing Ecological Problems in the Three Gorges Water Conservancy Area

As early as the beginning of the Three Gorges Project construction, the government determined the guideline of ‘water and soil conservation, synchronized construction of ecological environment and the project’. It also took measures for those damaged site caused by construction, such as land leveling, plant covering and engineering protection, built large quantities of protective works, land rectification works and greening works in term of rehabilitating the affected ecological environment in a certain way and building good foundation for the ecological rehabilitation of the project management area. However, certain problems still remain to be solved.

- The Three Gorges Water Conservancy Area is affected by ecological decline in the surrounding area of The Three Gorges Water Conservancy Area.

Construction of the Three Gorges Project remarkably changed the structure and functionality of the water ecosystem of the Yangtze mainstream.

- The integrity of the ecology system is affected by the fragmented or broken habitat complex in The Three Gorges Water Conservancy Area.

Before the Three Gorges Project, the project management area used to be an ecological area mainly covered by forest, bushes and wetland. As the construction area was limited in a relatively narrow space, the landscape of the project management area is more fragmented, showing man-made speckles from human activities not seen in the original ecology, which is a certain impact to the fundamental habitat in part of the project management area for plant growth like soil, hydrology and microclimate.

- Many vacant lands are left coursed by building water conservancy.

The dominant species and adjacent species lost their growing conditions coursed by large quantities of damaged sites. Cutting off the original energy context between plant groups on two sides of the damaged land will take a long time to build a new system.

4 Ecological Rehabilitation Methods for the Three Gorges Water Conservancy Area

Regarding to the problems above, the ecological rehabilitation of the damaged lands caused by construction will be introduced as follows:

4.1Regional treatment methods

- Rehabilitating the Yangtze River ecological corridors in the upper & lower streams

The vegetation greening along mountainous regions surrounding the Three Gorges Project shall be restored, including less construction, conversion of farmlands to forests, construction of national forest park, so that combine the Yangtze Three Gorges ecological corridor and rehabilitate original environment to the maximum.

- Integrate artificial construction tactfully to regional ecosystem

The GIS technology was utilized for suitable land evaluation on the basis of ecological protection conception; and prohibition, limitation and construction zones are divided accordingly; the urban and town development zones were defined scientifically, so as to

protect the environment, utilize limited land resources effectively and intensively guide human activity within a confined space.

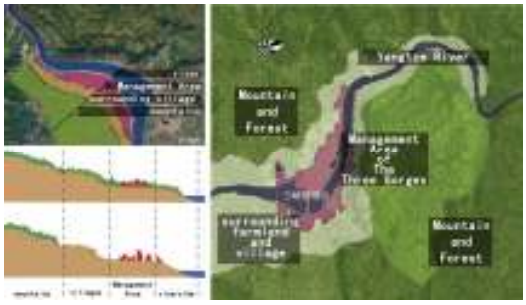

Figure 2 Combine the ecological corridor (Source: the Conservation and Redevelopment Plan of Three Gorges District)

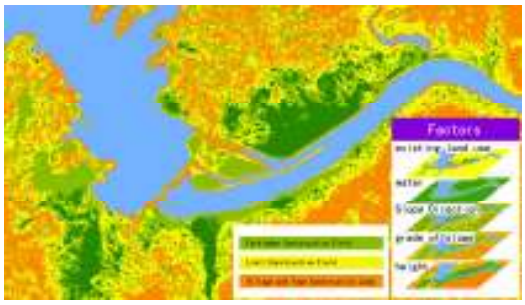

Figure 3 Define the construction land with GIS (Personal Achieve)

4.2 Site treatment methods

The discarded land in The Three Gorges Water Conservancy Area mostly consists of material stock yards, temporary workshops, warehouses and construction sites where the land was generally leveled as required for the project, leaving numerous steep banks and terraces that show remarkable artificial work without the original natural topographic features.

- Ecological rehabilitation by planting new species

For areas seriously affected by the project construction, the ecology may be rehabilitated by implanting new seedbeds. One strategy is to cover the slope with climbing plants. Another is to rehabilitate the ecology by planning new green species according to the size of the grades.

- Ecological rehabilitation by gardening

This strategy is to rehabilitate the vegetation by ecological gardening according to the surrounding environment and development construction requirement and to develop refreshing and elegant landscape ecological greens where plant populations coexist in picturesque disorder and an eco-landscape combination.

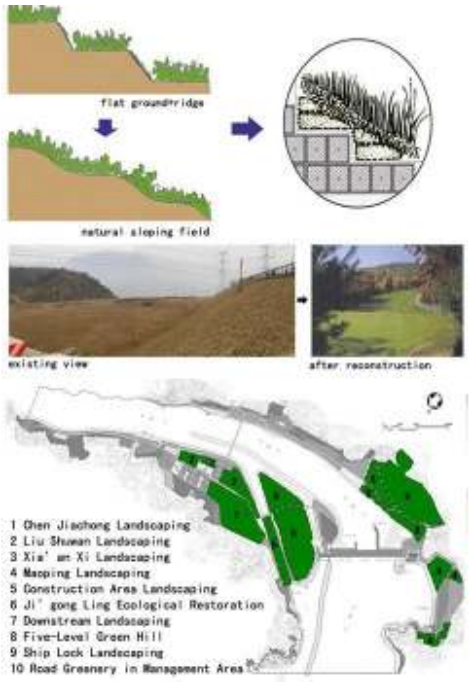

Figure 4 Ecological Rehabilitation for Destroyed Surfaces (Source: the Conservation and Redevelopment Plan of Three Gorges District)

4.3 Treatment with abandoned buildings and structures

There are 68 abandoned buildings and structures with conservation value on the site so far, including workshops, warehouses, office buildings, mobile workers' barracks and mechanical equipment, which either reveal the original production system or display modern scientific civilization.

4.3.1 Conservation strategies for abandoned buildings and structures

There are three strategies for conserving abandoned industrial buildings and structures.

Complete conservation and full exhibition: All the industrial heritage of Three Gorges Project should be completely conserved in order to exhibit the scene of construction in different area.

Correlation of the event and reappearance of the history: The display of historic events and historic people related to the Three Gorges Project construction could effectively keep a record for the certain period of local history.

Integral utilization and ecological treatment: The Three Gorges Project will gradually turn from the construction period to the operation period. Those historical heritages will accelerate the conservation as well as development during the operation period.

4.3.2 Conservation methods

- A combination of partly conservation and structure conservation

As no complete factory area practically exists in the Three Gorges Project area, we recommend partial conservation and structure conservation.

Take the large numbers of construction apparatuses remaining on the main construction site on the north bank for example which may make a good place to showcase the "project heritage" as a venue for visit, learning and experiencing by retaining structures and facilities of value with the help of functional houses, roads, pavements and plants.

Another example is the construction site on the south bank that lies down the dam and is near to the dam where people may watch the water draining at the dam. This system represents China's advanced level of hydropower construction with fairly complete equipment and may be retained to serve as an education and exhibition platform of water project construction. When ecological greening is added to the surrounding environment, this place will become an

important site for sightseeing, exhibition and education on the right bank.

- Reuse of buildings and structures

The buildings and structures left from the construction period could be maximum utilized. To the extent that the building spaces are in line with the new functionality in the operation period, it may be revitalized by function displacement and elevation renewal.

One example is the proposed Three Gorges Museum where the green architecture concept could be brought in made the original 8th Bureau Built-in Member Plant building into an earth-sheltered building to integrate it with the surrounding physiognomy and make a green ecological building of unique style that carries the regional features of the Three Gorges culture.

Figure 5 Abandon factory reused to be an Ecological Museum (Source: the Conservation and Redevelopment Plan of Three Gorges District)

- Reuse of waste materials

For new buildings, the green architecture concept shall be followed. Some strategies such as full use of local building materials and build green ecological buildings by energy-saving means, for instance, solar energies and natural daylight are all applicable. The materials on the site could be used so that industrial waste materials will become unique materials for landscape design.

Reuse of discarded buildings and structures after processing them. For example, discarded tiers may be used as road pavement materials, and brick or stone may be grinded into concrete aggregate, to name a few.

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