Social Capacity for Environmental Management
for Recovery of Greenery Resources in Hiroshima

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Abstract:
Having a population of 1.12 million (as of 2005) and an area of 741 square kilometers, Hiroshima City is regarded as a metropolis in Japan. On August 6th 1945, Hiroshima became the first city in the world to have an atomic bomb dropped on it, and the delta area was completely destroyed. Almost all of the vegetation was burnt and disappeared from the area. This paper summarizes the content and the achievements of every campaign carried out through the period after the dropping of the bomb in 1945 until 2005. The achievements of the first to third greenery campaigns were analyzed individually from the viewpoint of the Social Environmental Management Systems (SEMS). The first campaign corresponds to the system-making stage in SEMS, the second one is the system-working stage, and the last was categorized as the self-management stage. Compared with the brown issue, the time needed to attain the goals of each greenery campaign was required much longer, due to various struggles caused by urban development in the limited areas of the delta area. A case study was done on the small parks in the deltaic urban zone in the master plan of greenery. Unexpectedly new parks have fewer plants and simple structural diversities. Problems relating to the greenery policy and future direction of biodiversity conservation in urban areas are also discussed in the post-third greenery campaign.

Keywords: City park, Environmental management, Social capacity, Tree diversity, Urban ecology

1 Introduction

Rapid urbanization is a global phenomenon, especially in the post-war decades in Asian countries. The rapid urban growth in Asian mega-cities caused a chaotic mixture of urban land use in the periphery of the cities (Yokohari et al. 2000). Approximately, 80% of the human population from industrialized countries is concentrated on urban areas (World Resources Institute 1996). The urban areas have become the most common habitat for humankind (Sandström et al. 2006). Accelerated urban development has resulted serious environmental problems, including air and water pollutions, and created a fragmented land use of urban and rural forests in the fringe of
cities. Urban green areas are universally valued as recreational venues, wildlife refuges, and essential livable-city ingredients (Jim and Chen 2003). The urban landscape is highly regarded in understanding, maintaining, and managing biodiversity. A city with high-quality and generous green spaces epitomizes good planning and management, a healthy environment for human-being as well as for vegetation and wildlife. In the urban zones, radical changes in the mentalities and life-style of inhabitants have both contributed to the modification floral composition.

In the case of Hiroshima City, an atomic bomb blew out and destroyed almost all residences and aboveground vegetation. Soon after, the peoples survived started to plan recovery and establishment of greenery. During the last 60 years, the city government and citizens have made strenuous efforts to recover the greenery. Many plans and actions conserving greenery resource recovery could be traced and arranged into a process of progressive environmental protection. Through this survey, we have discussed the concepts in urban planning representing the case of Hiroshima City with the historical characteristics of greenery from the viewpoint of Social Environmental Management Systems (SEMS). We have also evaluated the greenery planning history and system as a tool to conserve biodiversity through the provision of sufficient quantity and quality of green spaces.

1.1 Social capacity for environmental management

The 21st century COE (Center of Excellence) program for Social Capacity Development for Environmental Management and International Cooperation is being implemented from 2003 at the Graduate School for International Development and Cooperation, Hiroshima University, Japan. In this program, focusing on the urban environment social capacity development for environmental management is one of the concerns being addressed.

Economic and social well-beings of people are the important components in the development of sustainable urban environment (United Nations 1992). The paradigms of sustainable development have produced new urban environmental management theories.

The Social Environmental Management System (SEMS) is defined as the system of interaction between the Social Capacity for Environmental Management (SCEM)
and institutions (Matsuoka et al. 2004). The SCEM will be realized by the government, civil society and the private sector working in partnership and it will support the development of local capacities, empowerment, decentralized management and initiatives. Examining the SEMS developing stage will also provide useful information to sustainable development.

2 Overview of Hiroshima City and research methods

Having a population of 1.12 million (as of 2005) and an area of 741 square kilometers, Hiroshima City (34°23´N, 132°27´E) is regarded as a metropolis in Japan. The Japanese economy grew rapidly from the 1960s. Rapid and massive migration of people into cities resulted in uncontrolled land use in the suburbs of Japanese cities, and Hiroshima City was not an exception. Figure 1 shows the landscape change in Hiroshima City. In 1948, residential districts were concentrated in the central delta and farmland existed along the valleys. However, along with the rapid economic growth around 1970, residential areas expanded and farmlands were changed to residential areas. Around 1994, the forest of outer downtown Hiroshima was developed to create a new residential area. In 2001, the master plan of greenery in Hiroshima City was made.

![Image of landuse changes in Hiroshima City from 1948 to 1994.](image)

Fig. 1 Landuse changes in Hiroshima City from 1948 to 1994. Area is in the full administrative area of Hiroshima City, Fuchu-cho and west part of Kaita-cho in 1994. Grid size is 250m x 250 m and landuse type is classified into forest farmland and residence (modified from Nakagoshi and Moriguchi 1999)
Five different zones of greenery resources were newly established by synthetic approaches for coexistence of human and nature (Fig. 2).

For the SEMS, it has three developmental stages. They are the system-making stage, the system-working stage and the self-management stage respectively. All of them are included in a capacity development. These three-stage of development are the basic framework for analyzing the development and the present situation of SEMS. The SEMS analysis for the development stage aims at specifying the development stage based on the benchmarks and then presenting the development process and the direction for future development. The development stages are divided using the SCEM as indicator and benchmark. However, it is difficult to measure the SCEM in direct, so usually SCEM is approximated by the environmental quality. Thus, the stage periods are divided by inflection point of the improvement of environmental quality.

Under this SCEM concept, we divided the urban greenery activities of postwar Hiroshima City into four periods using the SEMS concept. Our division focused on the city planning and government system of Hiroshima City after WWII, because of no data of the green space quantity and quality before 1985 in Hiroshima City. All greenery plans were discussed in each aim and impact.

The system-making stage focuses on the development of the fundamental greenery plans of the SEMS. In the system-working stage, the system actually starts functioning to improve the environmental quality. The self-management stage is the stage where in
the system develops in a sustainable manner through the strong interactions between the government, private sectors and citizens.

Vegetation survey and tree census were carried out at 197 commercial district small parks (< 1ha, in area the smallest park in the state category), in the deltaic urban zone in Hiroshima City. Survey period was conducted from 2001 to 2003. These urban parks were classified by cluster analysis (Ward's method) using layer coverage. To identify the characteristics of each group, we recorded the area and the year of establishment of the parks from the official ledger of urban parks.

3 Results

3.1 Recovery history of greenery resources

After atomic bombing, the buildings and trees within the 2km radius from the epicenter were burnt down, and most of the houses within the 3km collapsed (Fig. 3). Only Shukkeien garden located in the center of Hiroshima remained, because the area of this garden was bigger than other parks in the vicinity. Naturally, in the late 1940s after the A-bombing, there was a plan for recovering greenery. But, it did not prosper due to the lack of enough financial support. Hiroshima launched a war damage reconstruction plan in 1946. The plan included 35 parks and other infrastructures. In

![Fig. 3 Map showing the epicenter of the atomic bomb and bombed area of Hiroshima City. The deltaic urban zone includes almost the bombed area (Hiroshima City 1971).](image)

1949, the city was made ready to set up the public greenery program by producing tree seedlings in the municipal seedling fields. These programs were systematic planning, however there were no real progress. We regarded this stage as the pre-system-making stage. Then, we adjusted the plans and its performance in the development process of SEMS. The result is shown in Fig. 4.

### 3.2 First stage or system-making stage

The system-making stage is the one in which the fundamental functions of SEMS are developed. This stage particularly requires capacity development in the government sector. Hiroshima's green space planning and development activities began in 1950s. The town-planning law and Hiroshima Peace Memorial City Construction Plan were established in 1952. This plan included 78 parks (total area: 219.67ha, average area: 2.8ha/park) and eight green river tracts/strips. Under this plan, the Peace Memorial Park (12.21ha) was constructed in 1955 in the center of Hiroshima City. Also, riverside green tracts (21.32ha) were designated to enhance the attraction of the rivers flowing through the city from north to south.

In 1954, a large number of trees were donated to Hiroshima City from all over Japan following the request of the mayor of Hiroshima City to other mayors across the nation. This is how the First Phase Greenery Campaign was launched. A tree-offering

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### Table: Development of SEMS

<table>
<thead>
<tr>
<th>Before system-making</th>
<th>System-making</th>
<th>System-working</th>
<th>Self-management</th>
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<tbody>
<tr>
<td></td>
<td>Hiroshima City Reconstruction Bureau (1946)</td>
<td></td>
<td>Civil Network for Flower and Green (1999)</td>
</tr>
</tbody>
</table>

Fig. 4 The urban planning and green issues of Hiroshima City in the development process of social capacity of environmental management.
campaign was also carried out by the City mayor from 1957 to 1958. He called for trees to be donated for greenery under the slogan "A Dream-Hiroshima 20 Years From Now". The campaign was carried out with the cooperation of the citizens and the surrounding local governments. About 1,300 tall trees and many shrubs were planted and contributed a great deal in increasing the woody bio-mass in the downtown area. The peace boulevard was turned into a kind of park with trees and shrubs. This wide road with trees becomes the main green corridor from east to west. Finally, the first Hiroshima basic plan was designed in 1970.

3.3 Second stage or system-working stage

In 1975, the Mayor of Hiroshima made a speech entitled “Declaration of Greenery”, and the Second Greenery Campaign was started and lasted till 1980. In 1975, the Hiroshima City Greenery Promotion Committee was established. This committee was composed of members with academic backgrounds, some from the chamber of commerce and some from industry. This was the first time for citizens and the private sector, originally in an organized way, to participate in the greenery activities, though the membership was still limited.

After WWII, many wooden structures were erected in the district as temporary housing. Some of the buildings were built illegally in the postwar social disorder. To remedy this situation, the redevelopment project was carried out greenery in riverside strips since 1969. The project was completed in 1979. The activity developed another green corridor from north to south.

In 1980, Hiroshima City became a government ordinance-designated city. In the same year, the Greenery Fund was established. The Greenery Fund annually offered a subsidy to private schools and facilities to social welfare institutions. During this period, many trees were well planted mainly on publicly owned land. The plan was identified as the draft for future Master Plan of Greenery (2001). Then, in 1986, Comprehensive Greenery plan was established.

3.4 Third stage or self-management stage

Over the first 40 years, greenery campaign was government-led. However in 1994, when the 12th Asian Games were held in Hiroshima City, the Government-Citizen collaboration was performed successfully, and the growing interest in greenery was
demonstrated. Responding to this, the Third Greenery Campaign was launched in 1996 when the New Town Planning Law was established. The campaign also aimed to achieve the goal of the Green Fiesta Hiroshima 1997. Two major goals of the campaign were to upgrade the amenities of the city with flowers and trees and to improve vegetation quality through Government-Citizen cooperation. In response to the increasing recognition of those activities, the Civil Network for Flower and Green of Hiroshima was established.

Succeeding to the comprehensive greenery plan in 1986, the Plan of Greenery in Hiroshima City was finally established in 2001 after a long discussion, and in the same year the post-third Greenery Campaign was begun. In the Master Plan of Greenery in Hiroshima City, the role of Greenery in urban regions is characterized as “existence” and “use”. In order to define the roles which greenery plays in the city, functions and roles were categorized into five areas. These five points of view are: environmental protection, conservation of ecosystem, recreation, disaster prevention and landscape composition. Better organization and efficiency were incorporated in the guideline of the greenery policy and environmental and ecosystem conservation has become a major issue today. Also, the original aims to increase woody bio-mass and improve amenities, upgrading human health and providing habitats for wild plants and animals were newly added to the campaign targets. The present green infrastructures have not yet led to the promotion of a new conservation area and ecosystem networks. Because their structures are well not designed in the sense of landscape ecology.

In the concept of SCEM, the role of local government is to mobilize beneficiaries and stakeholders through participatory processes. The Hiroshima City government promoted citizen and private company participation for greenery activities in this stage. They promoted private land greenery, conservation of private green spaces and rooftop gardens for tall buildings.

3.5 Ecological review of the small parks
Species diversity can be determined by immigration, extinction, or speciation, and the relative importance of each depends on the spatial and temporal scales (Huston 1994). Tree diversity of parks is a resource for wildlife and plays an important role in supporting species to survive. This is particularly well documented in a recent survey comparing species diversity of park trees and bird species existence in urban parks.
In the Hiroshima urban area, the number and area of parks increased between 1985 and 1998 (Fig. 5). With increasing SCEM, it is observed that the number and area of parks have also been increasing.

Figure 6 shows the classification of 197 parks in the Hiroshima urban area according to tree diversity. The parks were divided into three groups. The characteristics of each group are shown in Table 1. Group A is characterized by regular area and rich tree species. *Zelkova serrata* was the dominant species in group A.

(Blair 1996, Clergeau et al. 2001, Melles et al. 2003). In the Hiroshima urban area, the number and area of parks increased between 1985 and 1998 (Fig. 5). With increasing SCEM, it is observed that the number and area of parks have also been increasing.

Fig. 5 Trends of all parks in number (a) and area (b) in Hiroshima City from 1981 to 2002 in two different stages of SEMS. (Source: Local Public Finance Bureau, Ministry of Internal Affairs and Communications 1982-2003 the Public Facility Survey)

Fig. 6 Three groups classified by cluster analysis in the commercial district parks (small parks) in the deltaic urban zone of Hiroshima City in 2003. Ordination of parks which are abbreviated in inner clusters. Total no. parks: 197 and they are classified as the 77 (group A), 77 (group B) and 43 (Group C).
parks in group A were constructed between 1960s and 1970s, during the system-making stage (Fig. 7). The parks of group A were wide distributed in center delta area (Fig. 8). Group B is characterized by small area and middle species diversity. The dominant species in group B was *Cinnamomum camphora*. Most parks in group B were established in the 1980s during the system-working stage. Group C is characterized by small area and low species diversity. Most parks in group C were made in the 1990s during the late stage of system-working stage. The parks of group B and C were distributed in periphery of downtown. These results suggest that with an increasing SCEM, more small parks may have been constructed. This phenomenon may have been caused by the unavailability of large public areas for construction of new parks in the periphery of downtown. Then after, the self-management stage of SEMS has started to associate with citizen’s collaboration on park management.

Table 1. Characteristics of the commercial district parks in the deltaic zone of Hiroshima City

<table>
<thead>
<tr>
<th>Group</th>
<th>Relative area</th>
<th>Stratification and Coverage</th>
<th>Relative tree diversity</th>
<th>Years of establishment</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Standard</td>
<td>Rich and dense</td>
<td>High</td>
<td>1960s-1970s</td>
</tr>
<tr>
<td>B</td>
<td>Very small</td>
<td>Mid</td>
<td>Low</td>
<td>1980s</td>
</tr>
<tr>
<td>C</td>
<td>Very small</td>
<td>Poor</td>
<td>Low</td>
<td>1990s</td>
</tr>
</tbody>
</table>

Fig. 7 Establishment year of the groups among the commercial district parks in the deltaic urban zone, Hiroshima City. Data are shown by box-plot.
4. Discussion

Sixty years effect of greenery recovery presented a relatively rich biotic environment in the deltaic area/downtown of Hiroshima City. Many projects, particularly greenery campaigns resulted to the improvement of greenery resources in the city. Here, we focused on current problems and limitation of biodiversity improvement in the city throughout the field survey, because it showed the turning point from system-working stage to self-management stage of SEMS.

In recent years, appropriate management of urban green space has become a major issue for sustainable development. There are various functions in urban green spaces. Biodiversity conservation is one of them. However, biodiversity is considered as a minor consideration in environmental policy, and is still regarded as very general and too vague to be applied to real-world regulatory and management problems (Fig. 4). Actually, before 2001, there was no consideration pertaining to the greenery promotion plan referred to ecological and environmental conservation (Hiroshima City 2001). From an ecological point of view, habitat area and its number are important factors for ecosystem conservation. However, it was already difficult to obtain the large open public area to support the various species coexistence (Table 1). So, the government

Fig. 8 Distribution of three groups of commercial district parks in the deltaic zone of Hiroshima City in 2003.
has created small and many parks (Fig. 5).

At first, the number and area of the parks in Hiroshima City has increased linearly in the process of increase of SCEM. In particular, during the late system-working stage, the increase in the total area of parks was observed characteristically. However, due to the area dependent problems, the ecological quality (e.g. tree species diversity and vegetation structure) has deteriorated. Our result showed a positive relationship between tree species richness and park size, which seemed to support the relationship predicted by the island biogeography theory (MacArthur and Wilson 1967). It is thought that the time when a park was established is an important element. The planning and obtaining of large open spaces for greenery at the initial stage are very crucial.

However, the lack of public land for greenery accelerated the collaboration of local government, citizens and the private sector. Private areas constitute a substantial proportion of 'green space' in urban areas and hence, are of potential significance in maintaining biodiversity in such areas (Gaston 2005). However, most private areas are small. They may not be enough to evaluate the environmental quality, but effective to enhance the ecological network for some wildlife as temporary habitats. Creation of high quality habitat in private areas is necessary to develop the ecological networks to maximize the effectiveness of dispersal and movement for wildlife. Management should be complemented by environmental education to increase public participation, and by research to get new information to correct and re-define management strategies (Fernández-Juricic and Jokimäki 2001). In urban landscapes, people are the most prevalent biological element. Urban landscapes represent a huge opportunity to increase active public participation in urban wildlife conservation as well as to promote conservation of other threatened habitats (Savard et al. 2000).

To increase urban species diversity, large parks provide a larger diversity of habitats necessary to hold many species with different habitat requirements. This was documented in a recent survey that compared the species diversity of ants in city parks and remaining forests. Ants are good bioindicators of various environmental parameters (Yamaguchi 2004). It is easy to identify and collect ants, because they are abundant in many terrestrial ecosystems, and they occupy higher trophic levels (Majer 1983). Yamaguchi (2004) found a positive correlation between ant species richness and park age and area in Chiba. But in Tokyo, no positive correlation between ant species
richness and park area was found. Kohno et al. (2003) reported the positive correlation between ant species richness and year of park establishment in Hiroshima City. In Hiroshima, the park area was dependent on the park age. In other words, bigger parks which are established in early stage of plan have positive correlation with ant species richness. The park age may indirectly affect biodiversity. The progress of urbanization reduced ant species richness in urban parks.

It is easier to obtain information on number and area of green spaces than biodiversity information. The achievements of initiatives to strengthen biodiversity conservation in developing countries may be difficult to assess, since most countries have no system for monitoring biodiversity. For increasing number and area of urban parks, SCME was effective. However SEMS is not yet performing well to recover the ecological function.

Greenery activities are still being conducted now, but will never be terminated. Issues remain, in particular relating to small scale city parks which are not situated in the public plan. Roadside tree species with poor diversity, disconnection of each green space making it impossible to attain the ideal green network, less vegetation cover on the coastal industrial zone, are all problems which must be solved. Scientific solution of these problems must be found in the landscape ecological achievement (Forman 1995). Hiroshima City is known as the International Peace City, has been proudly working for world peace, and so high standards must be demonstrated regarding the quantity and quality of green spaces.

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References
広島大学21世紀COEプログラム「社会的環境管理能力の形成と国際協力拠点」
ディスカッションペーパー


Vol.2003-3 吉田謙太郎（筑波大学大学院システム情報工学研究科）都市生態系の社会経済評価, 2004/3/31


Vol.2005-7 Yosida, K. (Department of Social Systems and Management, University of Tsukuba) Benefit Transfer of Stated Preference Approaches to Evaluate Local Environmental Taxes. 2006/1/29.


Vol.2006-1 村上一真・松岡俊二 (広島大学大学院国際協力研究科) 都市大気質と経済成長および社会的環境管理能力の因果構造分析, 2006/7/10.