



Sustainable Symbiotic Relationship in The Human Ecosystem in The Development of Public Spaces (Case of Hanoi Historical Inner-City Area)

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Abstract: In the last few years, the concept of the Human Ecosystem has been mentioned a lot frequently in Urban Environments related to social and natural ecosystems. The organization of public spaces cannot help but affect the relationships between human and natural ecology, economy, and culture. Perhaps the human activities have compromised the ecosystem so those relationships can be easily broken down. But it can also be enriched or recovered from failures by establishing Symbiotic Relationships between natural, economic, and cultural elements in urban ecosystems. The research presents theoretical issues of Human Ecosystems in public space organization and specific applications in the case of Hanoi historical inner-city areas. It focuses on discussing theories of the structure and morphology of Human Ecosystems, the human behavior, the relationship between community behaviors, natural environment, and architecture of public spaces, to organize, enrich, and balance the service ecosystem of public spaces. These features are considered vital by the author in contributing to the preservation of natural resources, urban architectural heritage, creating architectural spaces and planning of public spaces towards ecological and green urban development.

Keywords: Human ecosystem, sustainable symbiotic, public space, urban space, historical inner-city, urban heritage, Hanoi

1. Introduction

In recent years, major cities in Vietnam such as Hanoi, Ho Chi Minh City and Da Nang are all aiming to develop an extremely popular model in the world - "Smart city". Smart cities should not be understood merely as cities supported by 4.0 technologies, but rather, the constituent factors of cities are organized and operated by smart minds. With this point of view, the issue mainly lies in the "awareness" of parties involved in urban operations, including three sides: city government, investors, experts and urban communities, orienting towards critical resources that constitute the urban

ecosystem such as: natural resources, socio-economic resources, cultural resources (Coelho, P., Morales, E. M., & Diemer, A, 2017). The city's future lies within each component's opinion of behavior.

In particular, the development of public spaces in cities in Vietnam, especially in the historical inner city of Hanoi has experienced a disturbance in the relationship between humans and the natural environment at a system level, including the social and natural system of the area. The general situation of Hanoi is not only the lack of space for community activities but also the break in the connection among elements in the human ecosystem. Public space development projects are highly interested and prioritized for investment by the government; however, they have not facilitated to create opportunities for the Human, Natural and Socio-economic factors to form connections. These development projects can even disrupt the structure of the existing biological ecosystem and human ecosystem. For this reason, it is crucial to connect sustainable symbiotic relationships of ecosystems and factors in the human ecosystem of public spaces.

In order to implement this idea, it is necessary to study the complexity of those symbiotic relationships in organizing public spaces, where the human ecosystem emphasizes a strong relationship between humans and the natural, social and economic ecosystem. In the process of urban development, the human ecosystem has experienced changes due to human impacts. Some experts call it Ecological Change, which is a biological or physical transformation from one single ecological system to another (Low, B., Costanza, R., Ostrom, E., Wilson, J., & Simon, C, 1999). In this process of ecological change, there are ecosystems becoming independent and closed from other ecosystems; however, they can also interact positively or negatively for other ecosystems. The research on symbiosis of individual ecosystems will create opportunities for metabolic factors in the ecosystem to be exchanged, shared throughout, and as a result, forming a closed cycle within the large ecosystem. This will firstly, save metabolized energy from natural and human resources (Middle, I., Dzidic, P., Buckley, A., Bennett, D., Tye, M., Jones, R, 2014); secondly, cause no damage to the indigenous ecological structure, especially in areas of historical and cultural values; thirdly, facilitate exchange, symbiosis for changing factors in the human ecosystem with the principle of gaining mutual benefits for both sides.

The article sets out research and application objectives in the specific case of this project in order to: (1) Enhance the understanding of sustainable symbiosis among elements in the human ecosystem in the development of public spaces, (2) Identify and establish a symbiotic relationship of elements in the human ecosystem in the organization of public spaces, (3) Develop methods for sustainable symbiosis of elements in the human ecosystem in its symbiotic relationship with the urban ecosystem. The case study of the historical inner city of Hanoi is used to explain the applicability and research tools to establish a sustainable symbiotic relationship.

2. Methodology

In this article, our research team discovers the potential in symbiotic relationships among socio-economic groups, the conservation of cultural heritage and natural resources in the development of public spaces, with the aim of providing ecosystem services for the urban community. An extensive review of international literature is conducted, with a special focus on definitions and concepts of sustainable symbiosis among factors of the human ecology in public spaces in its symbiotic relationship with the urban ecosystem. Our team starts with a case study approach in two cases: one is organizing multifunctional public space that is associated with cultural heritage, the other is organizing public space - a combination of flower gardens and squares that is associated with the conservation of natural ecosystems. Following this, these specific case studies are presented on the potential of public spaces in Hanoi, especially those with high public access and managed by local residents to increase the ability to provide crucial ecosystem services of underutilized public spaces. Our team concludes by looking at several challenges to this integration and some strategies to overcome them, one of which is the applicability of Digital Technologies.

3. Literature Review

3.1 Human Ecosystem

The definition of "ecosystem" originated from biological research, which was a field in sociology in history during the 1920s and 1930s. A human ecological model follows the general ecological model, where organisms interact with their environment. The organism, the environment and their interaction form an ecosystem. They can be either large or small. For this reason, the ecosystem is a multifaceted concept and can be applied in many different situations.

The human ecosystem can be considered as a coherent system of physiological and social elements that are adaptable and sustainable over time, perceived at several hierarchical levels. For this reason, a unit of household, community, country, region, country or even planet; can be considered as a human ecosystem (Machlis, G. E., Force, J. E., & Burch, W. R. Jr., 1997). To put it simply, a particular human ecosystem can be hierarchically integrated into other human ecosystems at different scales - larger or smaller. Therefore, these human ecosystems at different scales have a strong connection among them.

The basic model of human ecosystem. There are numerous basic conceptual models with the aim to agree on human and ecological approaches to the ecosystem. One of the most prevalent approaches is acknowledging the existence of human and natural ecosystems, and then introducing mutual connections between them (Coelho, P., Morales, E. M., &

Diemer, A, 2017). In the 1950s, researchers made an effort to link social systems and biological systems, along with the interaction among four key variables: the population, the organization, the technology and the environment. However, in the 1980s, scientists utilized the human ecosystem as a theoretical framework. In particular, the sociological approach to the human ecosystem has allowed researchers to consider the flows and cycles of important social and biological resources (energy, materials, nutrients, populations, genetic and magnetic information, capital, organization, beliefs, and heritage) and to consider dynamic social and biological allocation mechanisms (ecology, exchange, authority, tradition and knowledge) (Parker, J. K. & Burch, W. R. J, 1992) that influence the distribution of important resources in the human ecosystem (Grove, J. M., & Burch, W. R, 1997).

The research of Machlis and his colleagues (Machlis, G. E., Force, J. E., & Burch, W. R. Jr., 1997) indicated that although the scale of human ecosystems can differ, there exist certain essential factors. These factors are provided in a working model, which has been widely recognized and discussed in studies of the human ecosystem until now (Fig. 1).

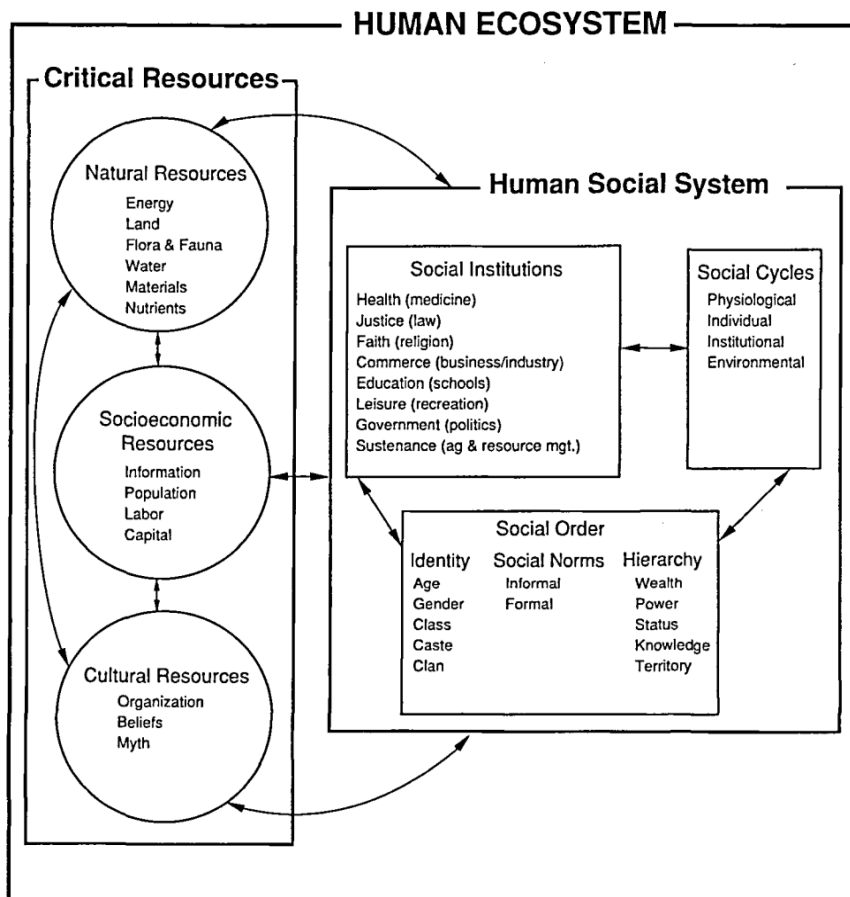


Fig. 1 - Working model of the human ecosystem (Wangatia, M. V, 2014)

Key components in the Human ecosystem. According to Machlis, the human ecosystem consists of three critical types of resources: natural resources, socioeconomic resources and cultural resources.

- Natural Resources include all of the following elements: energy, soil, water, materials.
- Socioeconomic Resources such as information, population, labor and capital.
- Cultural Resources such as organization, myths and beliefs.

These resources are regulated and operated by the human social system. This system comprises three subsystems: social institutions, social cycles and social order. These resources and social systems form a strong link, a minor change in a resource or a social system will lead to the change of the whole human ecosystem.

The transformation of the ecosystem in relation to humans. The transformation of the ecosystem is relevant to human decisions. These decisions affect the resources and livelihoods of residents. Will the decisions enrich the natural resources or increase the income of the people? In another perspective, ecological change relates to the independent functioning of firms. They are factors that can have influences on the income of other groups. In addition, ecological change can be related to the objective impacts of climate change but also to positive or negative human behavior towards

natural resources, including the phenomenon of land shrinking to yield natural surface to construction works, or forming a renewable natural fund and a non-renewable natural fund.

In this interactive relationship between people and the human ecosystem, there are two systems: Production and Consumption: one creates and the other consumes. This relationship is always maintained in the exchange system, the input of one group is the output of the other. The outcome of economic growth will depend on this symbiotic relationship. In the context of a market economy, socio-economic resources are often considered more important than the other two resources, which leads to the transformation of the human ecosystem. The historic inner-city area of Hanoi is an example when natural resources such as the surface water system, the green trees interwoven in the old quarter have disappeared, cultural factors also gradually fall into oblivion to make room for the market economy. (Fig. 2)

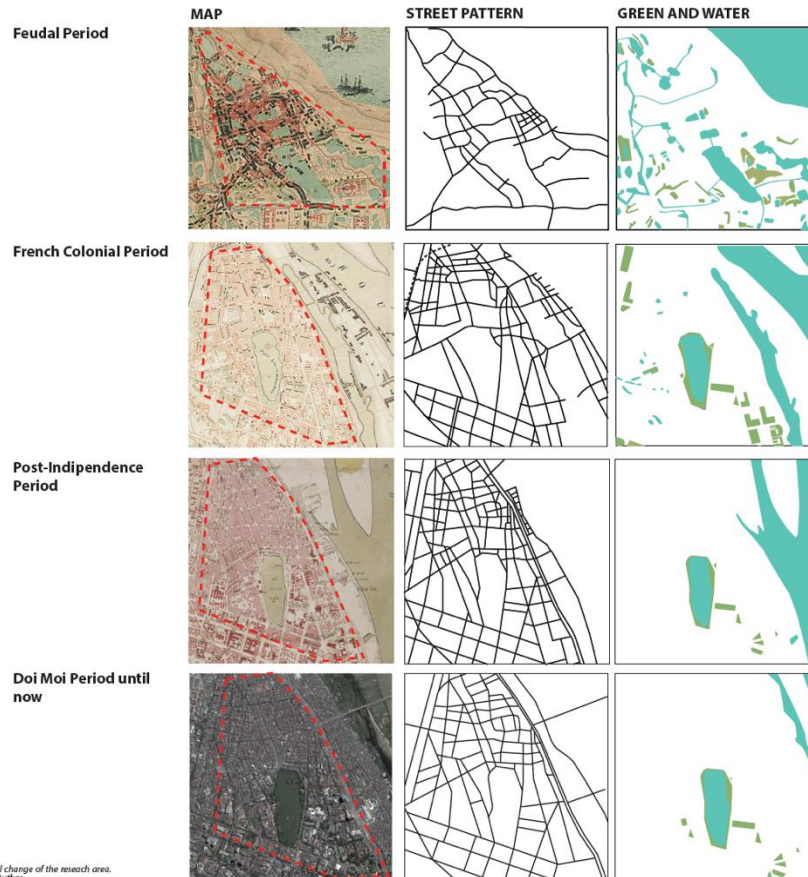


Fig. 2 - The change of the nature resources in the inner-city area of Hanoi city (Pham. H. V, 2017)

Human ecosystem restoration by culture. As discussed in a recent ecology and culture restoration symposium, it shows that the goal of ecological landscape restoration is to return as much structure and ecological function of the desired landscape as possible, and the goal of landscape restoration culture is to restore the historical and cultural values of the ancient and traditional landscape. Within the human ecosystem, it is crucial to restore the biodiversity, ecology and culture, along with the structural, functional integrity and the uniformity of the landscape (Naveh, Z, 1998).

By integrating culture into the landscape restoration function, we have established a symbiotic relationship between concepts and research methods, including natural sciences, biology and ecology-humanity. There is a need for a holistic, multidisciplinary perspective that recognizes interlinked relationships at levels, sometimes chaotic relationships between natural and human ecological systems. In this direction, there are research groups on Restorative Ecology JUNE 1998, Ecological Economy. It is undeniably a transdisciplinary effort to connect the natural sciences and the social sciences, especially ecology and economics (Naveh, Z, 1998).

3.2 Urban Human Ecology

The human ecosystem in the organization of public space from a sociological perspective. The human ecosystem in the organization of public space from a sociological perspective needs to be seen in regards to the leading role of humans in the idea of shaping the organization of public space. While discussing 'Space Practice' from the perspective of

Henri Lefebvre's Visual Sociology, David Harvey noted that those in command always create spaces that can regenerate and enhance their own power on the basis of urban citizens' local lives (Naveh, Z, 1998).

Harvey also argued that different classes all tried to establish a sense of their territory and their community. In fact, this factor is often ignored by earlier theorists. They claimed that there needs to be some ideal, typical and universalized trend for all to build a fairly similar community space, regardless of political or economic circumstances.

Pierre Bourdieu noted that the production of symbols in space mainly serves the idea and the mechanism it implements to "restore the established order and the remaining hidden permanent domination". People manifest themselves in their daily lives. In this case, Bourdieu's point of view on "habits" or generated activities is useful in studying the role of an idea leader (Naveh, Z, 1998).

The human ecosystem in the organization of public space from a perspective of conserving or restoring natural resources. Integrating green space planning into public spaces in the form of flower garden parks will create a new direction in providing ecological services in urban spaces. This integration will contribute positively to community development (bringing green-ecological space into the community environment). Residents, thanks to the green system, will increase their physical activities, conduct walking activities right in the neighborhood. In the opposite direction, local people can actively participate in green space development planning, and at the same time can convey the awareness and education to protect the green space network in the ecosystem (Krase, J, 2018).

3.3 Symbiotic Relationship in The Human Ecosystem

The symbiotic relationship between urban areas and rural areas. There is a symbiotic relationship between urban and rural areas. Agricultural production occurs in rural areas while industrial production occurs in urban areas. Rural areas provide agricultural products while urban areas consume these products. One cannot exist without the other. The 16th century marked a great deal in agriculture and human lifestyle. The movement of agricultural workers in the United Kingdom commenced in 1770 - at the same time as its Industrial Revolution. This event was in support of sustainable agriculture after 1770 and driven by the dissatisfaction towards Industrial Agriculture. From the 20th century to the 21st century, the symbiotic relationship between agriculture and industry, urban areas and rural areas developed even more strongly (Smith, G., Archer, R., Nandwani, D., & Li, J., 2017).

The symbiotic relationship between Nature and Humans. In an indigenous society, there are several physical-biological factors, human factors and supernatural factors. They are associated with each other in social relationships, they establish symbiotic relationships with each other to survive and develop. It is indispensable that socio-economic development be linked to environmental resources. Humans need nature to nurture, nature needs humans to take care of. The urban society, where people focus on living and doing business is the place that demonstrates this relationship the most clearly. It is necessary to discover a wise collaboration between humans and nature to ensure shared prosperity (Ferreira, S. L., 2011).

The symbiotic relationship between tradition and modernity. The building of a new construction on the foundation of an existing space will inevitably affect the ecosystem structure. Structural resilience is difficult, expensive and time-consuming. It is extremely challenging to persuade citizens, authorities and investors to participate to ensure total resilience of the ecosystem (Anderies, J. M, 2014). Tourism development and natural resource conservation are contradictory issues. However, they can become allies and can gain mutual benefits in the fight to protect the remaining natural landscapes if there is a sustainable symbiotic relationship (Boley, B. B., Green, G. T., 2015). This symbiotic relationship includes increasing biodiversity in natural resources, controlling floods, controlling carbon quality, preserving natural and cultural heritage. The conservation of nature has to start with the conservation of land resources. From there, the biodiversity and the ecosystem's health will be enhanced, resulting in the sustainable development of tourism.

In short, the city can be identified as a human ecosystem in which there exist many other ecosystems. These ecosystems have distinct elements. When these elements are put together to form a larger ecosystem, it has mutual value, harmonizes each other and helps each other coexist and develop. Accordingly, people can interact with each other on large and small scales of the urban human ecology, which is evident in the organization of public spaces.

4. Case Studies

As analyzed above, we can consider the public spaces in the historic inner-city area of Hanoi as single ecosystems in the overall human ecosystem of the historic inner city area of Hanoi. Based on spatial characteristics, two distinct manifestations of this area can be identified.

- *The Old Quarter area:* clearly shown socio-economic factors (high density, public space mainly for business and commerce).

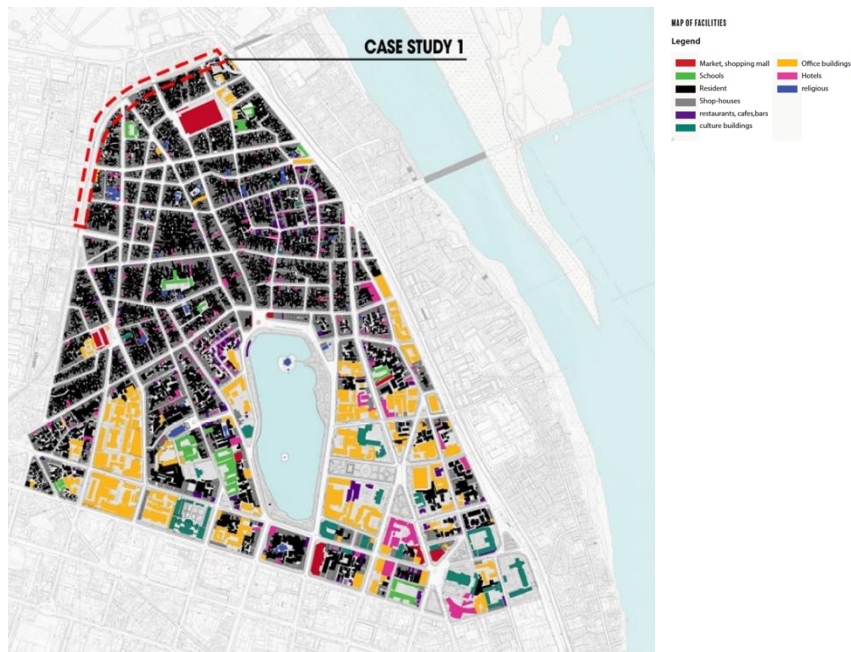


Fig. 3a - Function map of inner-city area (Pham. H. V, 2017)

- The area around Hoan Kiem Lake: nature resources are preserved (space for relax and entertainment)

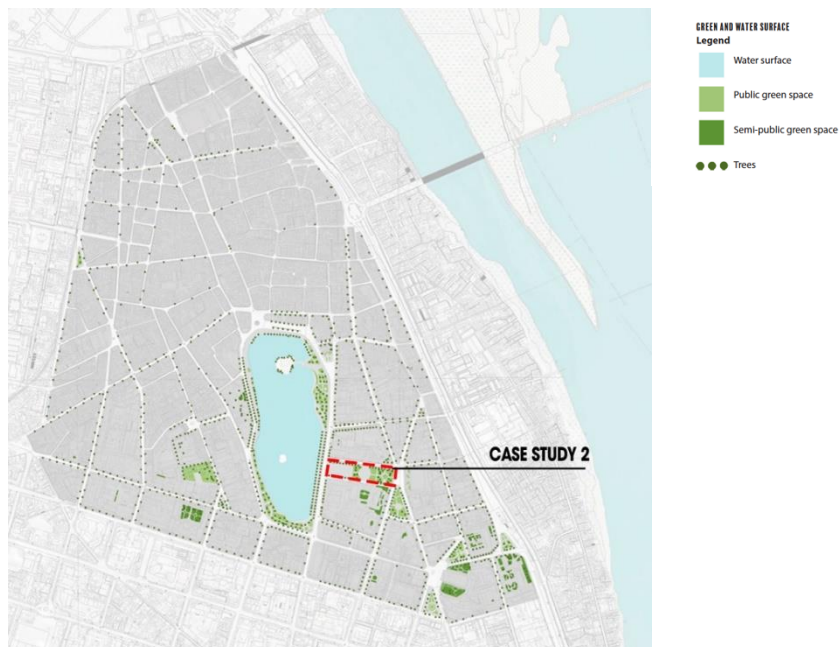


Fig. 3a - Nature map of inner-city area (Pham. H. V, 2017)

4.1 Case study 1: Public Space in The Area of 131 Train Bridge Arches on Phung Hung Street, Hanoi

Brief intro. The public space 131 train bridge arches are located in the Old quarter area with outstanding socio-economic features. The project aims to research, apply and emphasize on the symbiosis among socioeconomic elements in human ecosystem. The studied area is the urban railway line built by the French between 1900 and 1902 which runs across the center of the city, lies upon 131 train bridge arches and has been covered up since 1980. In 2018, the city proposed a project in which the bridge arches would be opened up to be transformed into a public space as well as a

tourist attraction spot. We researchers from UAI were given this opportunity to study and conduct the project with the aim to create a Center for Culture, Commerce, Services and Tourism.

Critical resources: The area has some distinct characteristics:

- It lies in the border between the Old Quarter in which traditional commercial activities take place and the French Area where the administrative and political centers lie in many colonial architectural heritages.
- The stone train bridge is considered as an architectural heritage that needs to be preserved. These two characteristics make the area a cultural resource of the surrounding area.
- The city would like to turn the area into a multi-functional public space: cultural, commercial, service, tourism; turn the place into a socioeconomic resource.

In this ecosystem, it shows that socio-economic factors play a key role. The goal of the project is to study and develop a new public space; moreover, to preserve the heritages, symbiotic the socioeconomic activities not only on the whole axes with the Old Quarter and the French Area but also different arches on the axis.

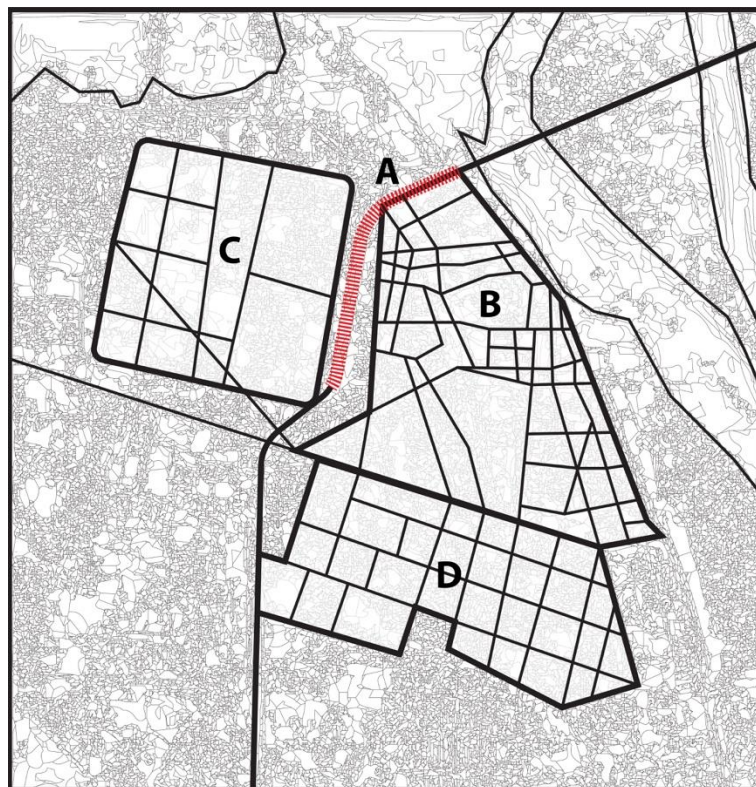


Fig. 4 - The 131 arches lies in the border between the Old Quarter and the French Area. (Doan, M. K., 2018)
A: The urban railway and 131 arches. B: The Old Quarter. C: Hanoi Citadel. D: The French Area

The methodology is to combine theoretical research and site study. Having surveyed the area, based on the symbiotic connection to the Old Quarter, we realized that we could create a stable symbiotic connection among the French Area, the 131 arches and the Old Quarter and turn it into a sustainable human ecosystem. The symbiosis derives from the analysis of public activities and the long-formed landscape in the area to divide the proposed public space into distinct activity-based area throughout the axis. Through the survey, the research teams realized that the area has great value in economic activities with multiple types of commercial activities. The survey showed that there are 4 main types of commercial activities with the following percentage:

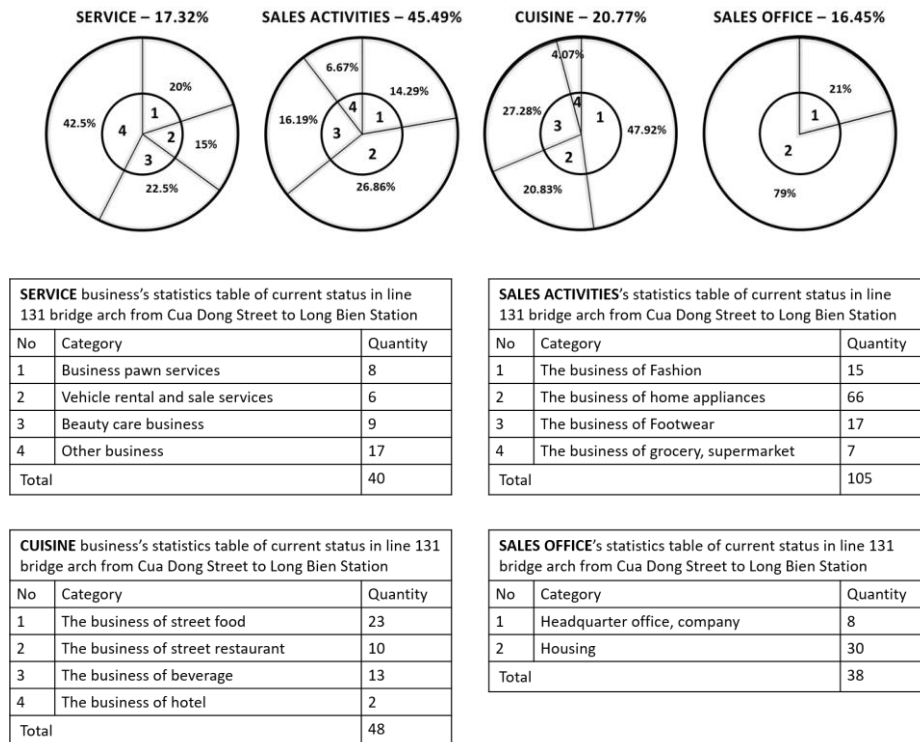


Fig. 5 - The result of the survey conducted on the business activities in the studied area (Doan, M. K., 2018)

Currently, there is little connection between different types of commercial business. However, the survey is not entirely perfect since the space along with customers’ demand is constantly changing through time. The applied research results. Based on the idea of restoring the human ecosystem by cultural factors (Navah, 1998), the authors have proposed to re-create the traditional trading space to increase the vitality and attractiveness of this ecosystem.

Identify the functionality of each section along the axis to enhance the symbiosis among economic elements of 131 arches. From the mentioned analysis, we proposed to divide 131 arches on the stone train bridge into 5 sections with 5 functions to ensure the symbiotic ability in the area, which includes:

- Section No. 1 (290 meters long), from N2 to N49 is Commercial Section. The activity on this section includes selling handicraft items. The section serves as a place for introduction and selling products in the Old Quarter. The relationship is mainly production - consumption.
- Section No. 2 (180 meters long), from N51-N76 is Cultural Section, on which public art is performed. The section is the meeting place for the traditional artists as well as a stage for art performance, which will serve as a welcoming place for tourist routes from the Old Quarter.
- Section No. 3 (125 meters long), from N78 to N93 is Traditional Culinary Section. The area surrounding is quite narrow but full with famous little sidewalk restaurants. This is the appropriate stopping point for Section 2, 3, 4 and 5.
- Section No. 4 (170 meters long), from N95 to N121 is Bazar Street. This section is close to Dong Xuan Market, so it would be perfect to host a traditional street market.
- Section No. 5 (70 meters long), from N123 to N131 is for creative start-ups and other technology development companies. This is the end of the axis, designated for young pioneers to start their own businesses.

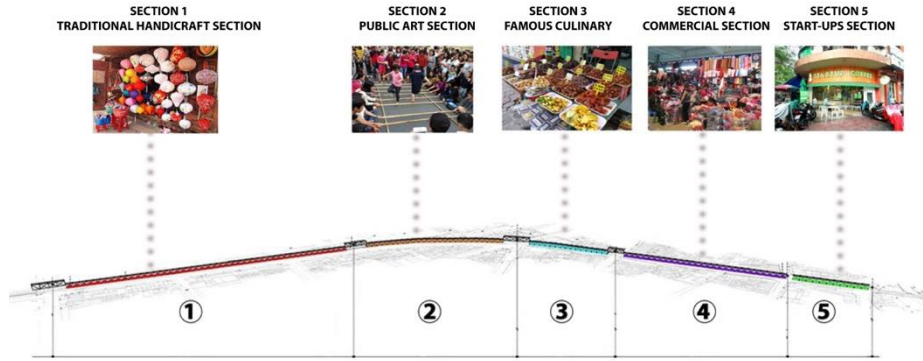


Fig. 6 - Division of 5 distinct sections on the axis (Doan, M. K., 2018)

To ensure the symbiosis of these resources is sustainable, the cultural resources proposed by the group to be transplanted into the ecosystem must meet the following criteria:

- Ability to complement each other when placed side by side (e.g., public art space attracts people to visit, entertain people to create a large number of customers for restaurant space or handmade souvenir store space)
- The new element must be able to coexist and co-develop with the old one, not lose the old one (e.g., architectural forms, the chiseling of the bridge arch does not lose the original shape of the arch architecture.)

Create ecosystems and sustainable symbiosis ability among them. By dividing the area into 5 distinct sections, we proposed 5 individual ecosystems connected to each other along the 131 arches, complementing and co-existing sustainably to become a multi-functional public center.

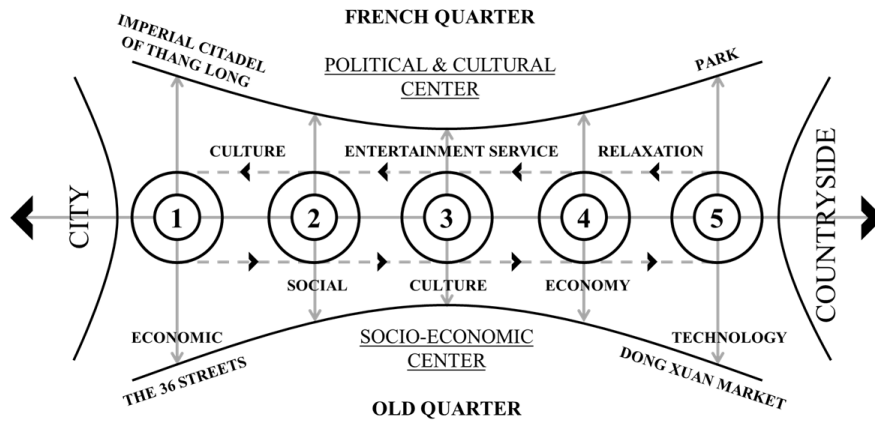


Fig. 7 - The symbiosis relationship among the 131 arches area, the Old Quarter and French Quarter (Doan, M. K., 2018)



Fig. 8 - An image of Section No. 2: Public Art space (Doan, M. K., 2018)

Apply digital technology in the symbiosis connection among areas. The application of digital technology would enhance the symbiotic connection among businesses. Therefore, all 4 types of businesses will cooperate better when using digital technology in gathering and transmitting information and data. The service and sales office would be the hub for demand and supply information. Therefore, digital technology needs to be implemented in both of them to provide data for activities of the cuisine area and other sales activities.

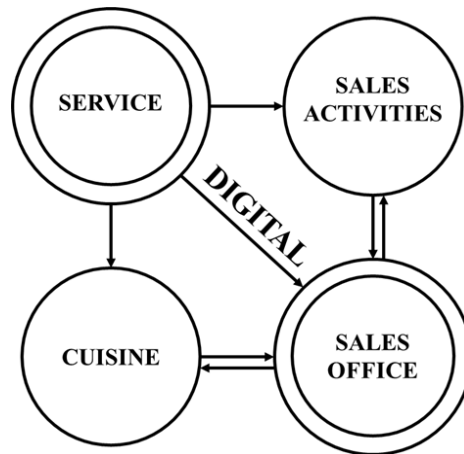
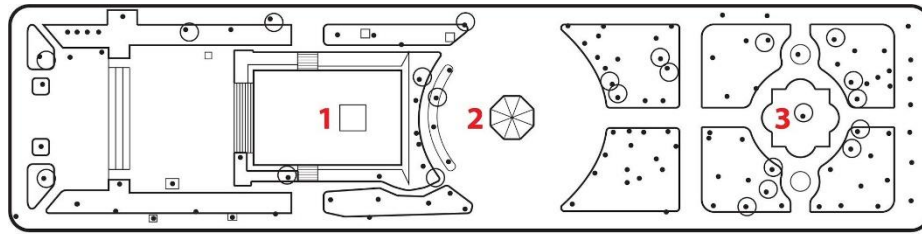


Fig. 9 - A diagram of the connection among 4 business types (Doan, M. K., 2018)

The case study shows that this is an ecosystem with outstanding socioeconomic characteristics. The addition of cultural resources with technological tools not only contributes to economic development but also restores the original resources lost due to the impact of the market economy. The impacts at a reasonable level with research not only do not break the inherent ecosystem but also make the bridge arch ecosystem become diverse and attractive.

4.2 Case Study 2: Kilometer Zero in Ly Thai to garden, Hanoi

Brief intro. This is a project for researching and applying the symbiosis between natural and social elements in a humanitarian ecosystem. The site is Ly Thai to garden beside Hoan Kiem Lake. The area is rich in natural resource and historical value. Standing in the middle of the garden is a statute of Ly Thai to, who moved the capital city from Hoa Lu to Hanoi. Since the site is planned to be Kilometer Zero of the city, the proposed plan is to remove some of the trees, reduce greenery, increase the area for public square to create a public space big enough to host a larger crowd, which in turn helps develop local tourism.



<i>Legend:</i>	<i>1. Statue</i>	<i>2. Public playground</i>	<i>3. Flower garden</i>
● <i>Location of existing trees</i>	○ <i>Trees that are in good shapes.</i>		

Tree No	The height of trees (metres)	The width of canopy (metres)
1	10	6
2	12	10
3	12	8,5
4	9	3
5	12	10
6	10	3,5
7	12	3
8	10	6,5
9	8	5
10	5	3,5
11	13	8
12	11	7,5
13	6	4
14	6	4
15	4,5	2
16	5	3,5
17	5,5	4
18	6	4
19	5,5	3
20	4,5	3
21	5	3,5
22	8	3
23	7	3,5
24	6,5	4
25	6	4
26	6	4

Tree No	The height of trees (metres)	The width of canopy (metres)
27	5	4
28	8	3
29	7	4
30	9	4,5
31	5	3,5
32	6	3,5
33	5,5	4
34	5	4
35	8	3,5
36	7	4
37	8,5	4,5
38	5	3,5
39	6	3,5
40	6,5	4
41	4	2,5
42	6	3,5
43	5,5	4
44	5	4
45	8	3,5
46	7	4
47	8,5	4,5
48	5	3,5
49	6	3,5
50	6,5	4
51	4	2,5
52	6	3,5

Tree No	The height of trees (metres)	The width of canopy (metres)
53	5,5	4
54	5	4
55	8	3,5
56	7	4
57	8,5	4,5
58	5	3,5
59	6	3,5
60	5,5	4
61	4	2,5
62	6	4
63	5	3
64	5	3,5
65	6	3,5
66	6,5	4
67	4	2,5
68	3,5	2
69	8	3,5
70	7	4
71	13	6,5
72	9	5
73	9	4
74	4,5	3
75	5	3
76	5,5	3
77	6,5	4,5

Fig. 10 - Existing plan and statistical table for trees (Urban & Architectural Institute, 2019)

We proposed to the city a new plan with the following proposal: (1) To preserve and conserve the existing natural ecosystem, including multiple trees and flower gardens; (2) Preserve architectural landmark which is considered as unchangeable (the statue, a musical stage built by the French); (3) Create stability and sustainable symbiosis relationship between the natural ecosystem and other cultural social activities.

Critical resources.

- Natural resources: the existing trees and grass connecting to the waterfront.
- Cultural resources: Ly Thai to Statue, the Musical Stage and other surrounding valuable architectural landmarks.
- Socioeconomic resources.

In this ecosystem, natural resources are the main factor, green plants, lawns, flower pots are distributed in Ly Thai to square and connected with natural resources of neighboring ecosystems like the Hoan Kiem Lake space.

Human social system. *The applied research results.* Based on the theoretical research and survey on natural and social heritage, especially emphasizing on historical and natural ecosystem, we proposed a plan to divide the area into 4 sections perpendicular to the view to the lake: Section 1 is for Kilometer Zero; Section 2 is for the Statue; Section 3 is a public surrounding the Musical Stage; Section 4 is a tranquil garden for the neighborhood. With these suggestion, the project created the following results:

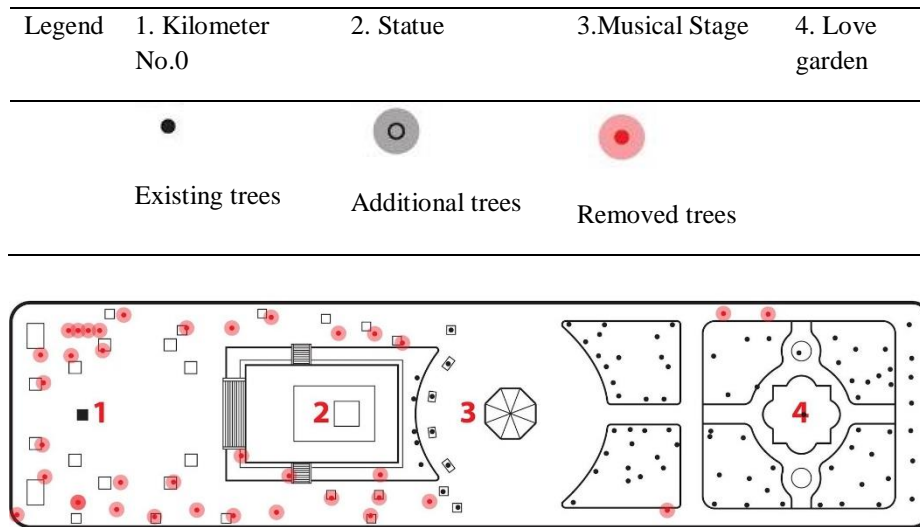


Fig. 11 - Landscape master plan by AREP

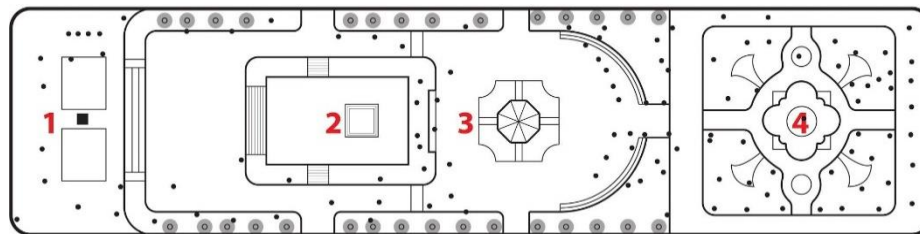


Fig. 12 - Landscape master plan by UAI

- The proposed goal of preserve the natural ecosystem, historical value and creating balance between Kilometer No.0 square and the garden is met.
- The symbiotic connection among tourism space (KM 0), sacred space (the statue), cultural space (the Musical Stage) and social space (the Love Garden) is established.
- A public space for everyone (including tourist and local), of all age, for official (public events) and unofficial (festivals).

The spatial analysis and organization showed that the allocation of natural resources (trees) and cultural resources (Kilometer No.0, Statue monument, Musical Stage, Love garden.) had contradictions, but at the same time is the harmonious mutual support, creating an attractive and sustainable for this ecosystem. The area of monuments, landmarks, and squares has less greenery (less natural resources), facilitating the gathering of people, organizing events (more cultural resources). The love garden area concentrates a lot of trees, grass (natural resources) to create a quiet resting space, in addition to separate high-density traffic from the crowded area.

5. Finding and Discussion

5.1 The Symbiosis Relationship Among Critical Resources (Nature, Socioeconomic, Culture) and Human Social System (Authority, Enterprise, Citizen)

From the 2 case studies presented above, we realize the existence of 3 factors: natural, socio-economic and cultural resources are available in case study 1 and 2. Even though socio-economic resources are emphasized in case study 1 and natural resources emphasized in case study 2. However, all 3 resources have symbiotic relationship with each other to support and highlight main resource. Human plays a very important role in the movement of the ecosystem, from

managing, adding, removing, adjusting and operating resources to best serve people as well as maintaining and developing urban ecosystems in general and public spaces in particular.

In a public environment, the sustainable symbiosis between Cultural (A), Nature (B) and Socioeconomic (C) pairs is involved in the conservation and development of symbiotic ecosystems. This relates to the symbiotic relationship between the human social system represented here by the Authority (1), Enterprise (2) and Citizen (3) in management, investment and develop the above resources. (Fig. 13)

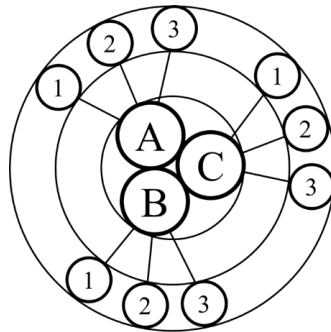


Fig. 13 - The symbiosis relationship among culture, nature, socioeconomics and human society

5.2 The Application and The Role of Information Technology into Human Ecosystem in Public Space

With the development of society and the rise of modern technology, the symbiosis within the human ecosystem in public space requires 3 crucial elements: culture, transformation and administration. Public spaces have always contributed tremendously in the economic growth of a city by attracting millions of tourists to visit by applying advanced technology, smart administration, along with the participation of multiple parties: government, architectural and urban planning experts, heritage experts, city advisers, residents and other parties.

In the process towards Evolution 4.0, where everything is shaped by big data analysis, Artificial Intelligence (AI) and Internet of Things, the combination of AI and other related technologies would help smooth the digital transition in general conducted at every level with requirements from each level of administration, so that the process would be utilized and more effective. Moreover, the administrators need to be more experienced and come up with precise orientation for the assistance of smart technology.

The symbiosis within the human ecosystem in public spaces requires adequate application of information technology to increase the effectiveness in preservation of cultural identity, transform in accordance with global development and smart administration, contributing to the establishment of a digital government with government and managers using technology and innovation to have better efficiency, creating new form of cooperation between human through using information technology and media to create a large collection of data and easily accessed, open and close administration procedures, ensuring balance of economic growth, heritage conservation, improve social utilities and other public value. From those bases, the author researches to build a technology trend table (Table 1) and evaluates and recognizes which factors are suitable for the public space development.

Table 1 - Recommendations regarding implementing technology in public space

No	Technologies	Features	Application
1	Big Data	The process of a very large and complicated collection of data which conventional data processing applications could not handle. The term is often used to refer to using programs for forecast analysis, user behavior or other advance data analysis which extracts from a large collection of data without mentioning the size of the data set.	Collect, classify, manage data on the resources of the ecosystem, and help predict the addition or removal of resources to help the ecosystem function properly.
2	Internet of Thing (IoT)	A large network of devices connected to the Internet, including smart phones, security cameras, tablets and/or any other electronic devices equipped with embedded sensors capable of transmitting data through networks. The	Support to promote, attract attention to ecosystems, help ecosystem develop and survive.

3	Cloud computing	"things" collect and transmit data through the Internet in real time. The provision of computer resource as required from applications to data centers through the Internet. It provides a versatile and fast framework to connect to websites, humans and applications safely, and allows sharing information and resources in a large scale.	Support for storing and sharing data of ecosystems, serving research or communication to develop ecosystems.
4	Wireless Sensor Network (WSN)	Consists of a collection of sensing devices using wireless networks to coordinate and conduct collecting data and information scattered at a large scale in any condition and any geographical location.	
5	Artificial Intelligence (AI)	A wide-ranging branch of computer science concerned with building smart machines capable of performing tasks that typically require human intelligence. The efficiency of the models depends on the quantity and quality of the data, which can be obtained by applications, cameras, and sensors.	Support for the management and control of resources in the ecosystem, ensure balance and support sustainable symbiosis
6	2D/3D visualization	Using graphic soft wares to create 3-dimensional or 2-dimensional drawing of the architectural landmarks existing in the public space.	
7	Geo-visualization	A set of tools and assisting techniques to analyze geographical data by visualizing the interaction, on which a map can be covered and create additional information based on coordinates and/or GIS data.	Media and research service
8	Augmented Reality (AR)	The combination of data, graphic, sound and other sense-enhancement devices in the real environment in real time.	
9	Hologram	Aimed to create a hovering 3-dimensional image (hologram) without any kind of screen. This technology is widely used in art performances or public events, especially in public spaces.	Support the development of cultural resources, events

Conclusion

In conclusion, through a series of theoretical and 2 case studies on public space organization, these are the conclusion that we draw:

- All the elements of a public space have mutual relationship to each other in various levels, both directly and indirectly. They can create either negative, positive or neutral effect to each other during operation and development.
- Humanitarian ecosystem of a public environment derives from the relationship of human toward socioeconomic ecosystem and nature - society. Human could actively create a symbiosis relationship among natural, economic and social elements to preserve the historical and natural ecosystem, as well as enhance the connection among parties to reduce energy consumption and grow economic prosperity.
- The relationships between different elements are considered sustainable as long as they promote the advantages and hinder the disadvantages, so that all the socioeconomic goals are met without damaging the environment.
- In both case studies, the symbiosis relationship between Urban and Countryside area needs to be exploited in development of public space with an identity, as well as enhance the relationships of tourism development and cultural heritage conservation through the symbiosis relationship between the Old Quarter and French Quarter.
- For the historic inner-city area of Hanoi, this can be considered as an area where the public spaces play a role as the constituent elements of the human ecosystem of Hanoi. Although each public space has its own characteristics, maintaining its own ecological circle, but with the current and future development, the maintenance and symbiosis of them is very important and necessary.

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References

- Coelho, P., Morales, E. M., & Diemer, A (2017).: Analyzing symbiotic relationships in sustainable cities: A framework. European Union and Sustainable Development, Challenges and prospects, 192-217.
- Low, B., Costanza, R., Ostrom, E., Wilson, J., & Simon, C. (1999) Human-ecosystem interactions: a dynamic integrated model. *Ecological Economics*, 31(2), 227-242.
- Middle, I., Dzidic, P., Buckley, A., Bennett, D., Tye, M., Jones, R. (2014) Integrating community garden into public parks: An innovative approach for providing ecosystem service in urban area. *Urban Forestry & Urban Greening*, 13 (4), 2014, 638-645.
- Machlis, G. E., Force, J. E., & Burch, W. R. Jr. (1997) The Human Ecosystem Part I: The Human Ecosystem as an Organizing Concept in Ecosystem Management. *Society and Natural Resources*, 10(4), 347-367 (1997).
- Bubolz, M. J., Eicher, J. B., & Sontag, M. S. (1979). The human ecosystem: A model.
- Pickett, S. T., Burch, W. R., Dalton, S. E., Foresman, T. W., Grove, J. M., & Rowntree, R. (1997). A conceptual framework for the study of human ecosystems in urban areas. *Urban ecosystems*, 1(4), 185-199.
- Grove, J. M., & Burch, W. R. (1997). A social ecology approach and applications of urban ecosystem and landscape analyses: a case study of Baltimore, Maryland. *Urban Ecosystems*, 1(4), 259-275.
- Parker, J. K. and Burch, W. R. J. (2014): Toward a social ecology for agroforestry in Asia. In *Social science applications in Asian agroforestry* (W. R. Burch, Jr. and J. K. Parker, eds.), (pp. 60-84). IBH Publishing Co., New Delhi, India. (1992)
- Wangatia, M. V. *Solid Waste Management Practices: A Socioeconomic perspective*, 121
- Naveh, Z. (1998). Ecological and Cultural Landscape Restoration and the Cultural Evolution towards a Post-Industrial Symbiosis between Human Society and Nature: *Restoration Ecology* 6(2), 135-143
- Krase, J. (2018). *Seeing the local in global cities*. In *Public Space*. 1st edn. Routledge. London
- Middle, I., Dzidic, P., Buckley, A., Bennett, D., Tye, M., & Jones, R. (2014). Integrating community gardens into public parks: An innovative approach for providing ecosystem services in urban areas: *Urban Forestry & Urban Greening* 13(4), 638-645
- Smith, G., Archer, R., Nandwani, D., & Li, J. (2017). Impacts of urbanization: diversity and the symbiotic relationships of rural, urban, and spaces in-between: *International Journal of Sustainable Development and World Ecology* 25(3), 276-289
- Ferreira, S. L. (2011). Balancing people and park: towards a symbiotic relationship between Cape Town and Table Mountain National Park. *Current Issues in Tourism* 14(3), 275-293
- Anderies, J. M. (2014). Embedding built environments in social-ecological systems: resilience-based design principles: *Building Research & Information* 42(2), 130-142
- Boley, B. B., Green, G. T. (2015). Ecotourism and natural resource conservation: the ‘potential’ for a sustainable symbiotic relationship: *Journal of Ecotourism* 15(1), 36-50
- Doan, M. K. (2018). Research project - The centre of culture, commercial services and tourism in the area of 131 train bridge arches from Cua Dong to Long Bien Station, Hanoi
- Urban & Architectural Institute. (2019). Research project - Restoration of Ly Thai to Garden
- Pham, H. V. (2017). Restructuring the open space system in historical core of Hanoi, Vietnam, Master thesis in Politecnico di Milano

