Integrating qualitative and spatial approach to identify human-landscape interaction in the Umbulan Water Spring, Pasuruan, East Java

IOP Conf. Series: Earth and Environmental Science **501** (2020) 012029 doi:10.1088/1755-1315/501/1/012029

Integrating qualitative and spatial approach to identify human-landscape interaction in the Umbulan Water Spring, Pasuruan, East Java

V D Damayanti,[1] P T Putra,[2] R M Syahadat,[2] R Alfian,[3] B Nailufar,[3] B Leimona[4]

[1] Department of Landscape Architecture, Faculty of Agriculture, IPB University, Bogor
[2] Department of Landscape Architecture, National Institute of Science and Technology, Jakarta
[3] Department of Landscape Architecture, University of Tribuwana Tunggadewi, Malang
[4] World Agroforestry Centre (ICRAF) Southeast Asia

E-mail: veradd@apps.ipb.ac.id

Abstract. This study explored the relationship between users, i.e. the locals and visitors, and the Umbulan Water Spring landscape using analysis method that integrated spatial and qualitative approaches. The spatial analysis, which applied the scoring and weighting method was aimed to identify the physical landscape character of the site related to the suitability on the users' activities. The qualitative method was conducted to explore the users' perceptions of the site by applying interpretive research technique through in-depth interview. The result of the interview was thematically analyzed using the Cultural Value Models components as the deductive approach. The analysis outcome which elaborated the landscape physical character and perception showed that the users-site interaction led to the spatial misuse on the site throughout the time. Economy and social factors have likely driven this phenomenon. Furthermore, the two groups of participants had different perceptions which were influenced by their interests and place-bonding over the site.
Keywords: landscape perception, human-landscape interaction, qualitative analysis

1. Introduction

A better understanding of human as the landscape component is imperative in site analysis during the landscape planning process. This view is based on the fact that humankind plays a key role as the agent of change in the landscape. The change induced by their culture while culture to a great extent was a result of human adaptation to the landscape; thus, it has created human-landscape interaction.[1][2] Comprehensive information about the relationship of human and landscape helps us to understand the landscape values perceived by users which underlying their actions in the landscape. Moreover, knowledge about the human-landscape interaction over time useful for landscape planner, designer and manager to foresee users' behavior on-site development and in making strategies to minimize the adverse impact caused by human. Also, this approach assisted landscape architect in creating innovative plans that support sustainable and resilient landscape.[3]

Identifying human-landscape relation can be approached not only through spatial analysis of the material landscape, but also by scrutinizing the landscape perception of the users. Perceptions can be explored using a quantitative method, for instance, through a questionnaire; and also through a qualitative method. The advantage of applying qualitative

analysis is that it involves a smaller number of participants compared to the quantitative methods, in which it determined by the information saturation. Despite the observation takes time, it offers thick information which somehow cannot be assessed through the quantitative method.[2][4] This study combined spatial and qualitative methods to identify the human-landscape interaction in Umbulan Water Spring, which explored the relationship between man and landscape as the grounds to explain the processes of landscape change on the site

Umbulan Water Spring (UWS) is an important water source for people in the region. Having a high rate of water discharge, the UWS meets the water needs of surrounding communities and even of people in the cities as far as Pasuruan and Surabaya. The water is also exploited for commercial mineral water. Moreover, the site has become a place for local communities as well as people from surrounding areas to undertake various activities. Nevertheless, the site tends to be degraded. The objective of this research is firstly, to identify the human-landscape interaction in UWS that presumably influenced the landscape transformation; and secondly to observe the factors behind the interaction.

2. Method

The research was conducted in the Umbulan Water Spring, Umbulan village, Winangun district, Pasuruan regency, East Java (Fig. 1). It was carried out from August 2016 to March 2017. The research activities consisted of preparation, collecting primary and secondary data through site observation, interview and literature study; analysis of physical elements and perception; and synthesis to formulate the users-site interaction particularly in the context of the space use, the landscape meaning, and the impact on the site.

Figure 1. Location of the research area

2.1. Analysis of physical landscape elements

The analysis aimed to evaluate the impact of users' activities on the site. In order to do so, hydrological susceptibility, land cover, and the spatial distribution of users' activities on the site were spatially analyzed. Those three elements were overlaid to produce a composite map of the suitability of existing users' activities. The spatial analysis applied the scoring and weighting approach (Table 1).[5] The base map for this research was generated from Google Earth 2016.

Table 1. Criteria used in the physical landscape analysis

No	Elements (weight)	Criteria	Score
1	Hydrological spatial pattern (70%)	Core area (the spring) has high sensitivity, not suitable for intensive activities	1
		Buffer area, 50 m from water bodies; activities can be developed for limited activities	2
		Utilised area with low sensitivity; suitable for intensive activities	3
2	Land cover based on structure and proportion of buildings and vegetation (15%)	Predominantly built area	1
		Green open space without trees	2
		Green open space predominantly woodland	3
3	Community activities on the site (15%)	Intensive	1
		Semi-intensive	2
		Non-intensive	3

2.2. Identifying users' perception

This stage employed qualitative analysis using primary data collected through in-depth interview. The number of respondents predetermined 15 local adult inhabitants and 15 local adult visitors. However, only 14 respondents' responses from each group could be analyzed further. Their perceptions were explored through their responses on several questions related to their activities, the natural and artificial elements in the site that they aware of, users' knowledge about the past events related to the site, and their hopes for future development.

The interview results were analyzed using Atlas.ti version 7. The steps of analysis included coding, code comparison, categorizing, and conceptualizing. The coding on the interview transcription was done applying deductive and inductive techniques. The deductive approach was based on the *Cultural Values Model* as "an integrated conceptual framework for understanding the potential range of values that might be present within a landscape." In this framework, three fundamental components are used to understand the landscape and its values: (1) forms, consists of the physical, tangible and measurable features of landscape or space; (2) processes and practices, included human practices and natural processes and practices/processes that incorporate human and natural elements, covers past and present events and traditions; (3) relationships, refers to those derived from interaction among people, people-landscape interactions, and valued relationships within the landscape.[6] In this research, those CVM components used for the interpretation of respondents' information as an attempt to define their perception.[5]

The inductive codes became the sub-deductive-code which were derived from certain topics generated by respondents in response to the questions. The next stage was comparing codes of each respondent group to see if there were any particular patterns on their answers. Afterwards, the codes were analyzed based on themes and then conceptualized by identifying the relationship among the codes to understand how the changing occurred on the site and what factors that stimulated the changes.[5]

2.3. Synthesis

In this stage, the analysis results of physical landscape and users' perception were elaborated. The aims was to identify the type of users-site interactions, and the factors that caused the interaction which subsequently, influenced the site transformation.

3. Research area

3.1. Physical landscape characteristic

UWS is located at the south part of Winongan district. The area of the site is 16.59 ha situated in the north side of Umbulan village border, adjacent to Sidepan village. The site is about 22 km from the Pasuruan city center. The area has tropical climate with average annual rainfall is 2,435 mm, and the average annual temperature is 27.43°C.[7]

The altitude of USW is 25-50 m asl, and the landform was relatively flat (0-8%) at the

north and east side. The site had 8-15% slope on the north-west direction. This slope was resulted by the construction of the reservoir and the bathing pools, that made various ground elevation at the south part. The soil type of UWS is inceptisol which is suitable for crops.[8] Therefore, the site and its surrounding were utilized for rice fields, dry fields, perennials, besides woodland. While around the pools several trees were spotted such as Banyan, Indian-almond, Monkeypod, and Kapok trees. Orchard managed by the local inhabitants grown with banana, mango, taro, and jack fruit (Fig 2).

The site of UWS is part of Rejoso Watershed ecosystem. The average water discharge of UWS was 5,000 l/s in the 1990s. The water was used for piped water in Pasuruan regency, Pasuruan and Surabaya cities, irrigation, fishery, and water supply for Umbulan villagers.[9] The observation in 2015, however, showed that the water discharge decreased into 3400-4000 l/s. The decrease was triggered by the land conversion from forest to agricultural land, and the increasing critical land upstream from Umbulan until the slope of Bromo Mountain. Overused of underground water for the industry at the spring, the increasing illegal drilling, and the growth of population followed by settlement expansion were apparently contributed to the decreasing landscape quality of UWS.[10][11]

Figure 2. The site existing condition

3.2. Economy and socio-cultural aspects

Among the Umbulan villagers which predominantly farmers, several local inhabitants used the site for non-agricultural income. Their economic activities included collecting moss and opening food stall and refreshment kiosks. Formerly, the food stalls and kiosks which were built in the 1990s using government subsidy were centrally located in the north of the bathing pool. However, as the visitor number increased over time, it caused the establishment of the food stalls closed to the reservoir pool that had caused water contamination. The visitors who came to the site mostly came from Winongan district, Pasuruan, and Surabaya with recreation as the primary purpose.

Local inhabitants were doing diverse activities on the site such as bathing, washing, swimming, fishing, besides selling drinks and food. They also conducted traditional practices, including washing together every Friday and cleaning the pools once a year during

Ramadhan. People believed that the water was good for health, and there was a kind of spiritual power over the site. The customs and beliefs implied that UWS has shaped the local culture. This phenomenon created site uniqueness, but on the other hand, the site encountered environmental problems such as has been mentioned above.

4. Results and Discussion

4.1. Analysis of the suitability of existing activities

The analysis objective was to study the physical landscape quality of UWS related to the existing spatial use of people on the site. The analysis included the elements of hydrology, vegetation, land cover, and the intensity of users' activities. The results afterwards were overlaid to produce a map that indicated the suitability of existing activities on the site.

The analysis of hydrological susceptibility aimed to study the susceptibility of water bodies over any destruction. In this context, the water spring located in the main pool and the river were considered as the core zone. The area off-the core zone as far 50 m was considered as buffer zone on which it can be developed deliberately. While the utilized zone, which was the outer part of the site can be developed more intensively without underground water extraction.

The purpose of the vegetation analysis was to study the spatial pattern of vegetation on which the result was useful for the land cover analysis. The analysis map showed that the site was predominantly woodland, followed by shrubs in the form of dry-fields and rice fields, and ground cover. Meanwhile, the land cover analysis aimed to identify its proportion and pattern. The result indicated that green space with trees dominated the site (28.83%), followed by green space with shrubs (38.64%), built-area for pavement, road, fence, and buildings (27.31%). The proportion implied that trees as natural element still can be found, although a large part of the site has been transformed through agriculture and physical construction.

The analysis of users' activities revealed that the area of intensive activities 6.02% and mostly occurred in and closed to the pools where people washing, bathing, swimming, and open their kiosks. The area of semi-intensive activities covered 60.02% for agriculture, administration, and housing. While 33.97% area in the site was idle without activities. This fact implied that although the intensive activities engaged in a small area, it took place in the sensitive-core zone; consequently, it gave considerable impact to the site.

The overlay of all four elements resulted in a map of the suitability of existing activities in the context of space use (Fig. 3). The map shows that the unsuitable activities on the site (area 10%) tend to disturb the hydrological system since the area highly susceptible. The unsuitability was influenced mainly by intensive users' activities, and furthermore, the land cover on the area predominantly shrubs and built structures. The users' intensive activities in the core zone ecologically were not fit with the zone's vulnerability. The moderately suitable activity area (37%) resulted from the permanent buildings and infrastructure which were constructed within the buffer zone that to a certain extent may disturb the core zone. While the suitable area (53%) was formed for semi and non-intensive activities and buildings were found in the utilized zone, thus, caused less damage to the water spring in the core zone.

The overall analysis showed that the unsuitable and moderately suitable uses of space for activities did not seem congruent with the attempt to conserve UWS and have caused ecological damage. The subsequent analysis would identify the process behind the unsuitable use of space by exploring the users' landscape perception.

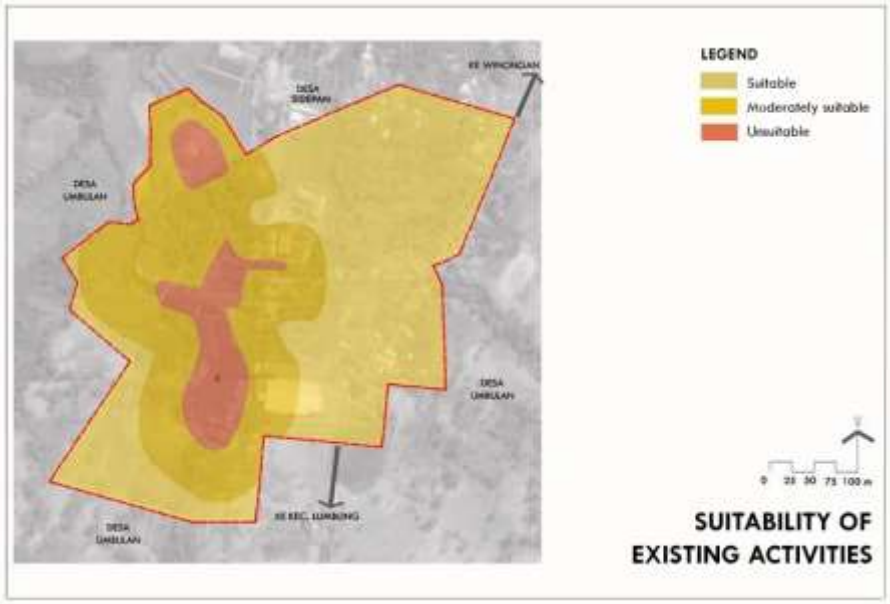

Figure 3. The map shows suitability of existing activities on the site

4.2. Analysis of users' perception

The perception analysis was used as an approach to studying the process of changes on site caused by human factor. The respondents of this research involved local inhabitants and visitors, with age between 19-74 years old. The length of the interview was not strictly defined, depending on the respondents' responses, but it must be at least thirty minutes to be able to cover all questions. Several interviews, in fact, lasted longer. The local respondents lived in nearby villages such as Umbulan, Sidepan, Mulyorejo, Penataan, dan Mendalan. Mostly they conducted activities in the site almost everyday (70%). The visitor respondents came from other areas such as Pasuruan regency and Pasuruan city who had visited the UWS several times, usually during the weekend.

With the Atlas.ti assistance, the respondents' responses were coded based on the CVM components of form, process, and relationships. Afterwards, the sub-codes were applied, which derived from the respondents' responses. From each CVM component, there are 12 sub-codes of forms, 26 of process, and 17 of relationships. The most sub-code discussed or mentioned by the local participants are: [form: vegetation], [process: site development over time], and [relationship: development with benefits for locals]; while by the visitor respondents included: [form: vegetation], [process: slow development], and [relationships: recreational development]. The recap of the CVM components discussed or mentioned by the respondents during the interview is displayed in Table 2.

The analysis revealed that the two groups perceived the site from two different points of views. This phenomenon was influenced by place attachment in perceiving the site; a psychological phenomenon that depends on the state of people-place bonding.[12] For the locals, UWS was part of their everyday life, either relating to the use of water for irrigation and domestic needs, or the use of the site for income. Meanwhile, the visitors perceived the site as a recreational spot. Thus, facilities and amenity became their primary concern. The lack of comfort due to inadequate facilities' condition on-site, such as toilet and changing room, were likely influenced the visitor's number based on the gender. This caused female visitors somewhat reluctant to come that had affected to the difficulty to find female visitor-respondent.

As shown in Table 3, the different point of view is clearly seen in their response to their hopes in future development. This difference is understandable since each group has different interests over the site. Carl Sauer asserted that the landscape interests influence people in valuing the meaning of landscape.[1] Furthermore, the different condition based on people-place bonding between the locals and visitors determined their perceptions. The level of people-place bonding can also be perceived by the number of respondents' responses. In Table 2, local respondents gave a larger number of responses on each CVM component compared to the visitors, which indicates the different level of familiarity to the site.

Table 2. The number of CVM components discussed or mentioned by the respondents

Component	Respondents' responses		Total
	Local inhabitants	Visitors	
Forms	84 (63.16%)	49 (36.84%)	133
Processes	213 (59.33%)	146 (40.67%)	359
Relationships	98 (50.52%)	94 (49.48%)	194
Total	396 (57.64%)	291 (42.36%)	687

Table 3. The recap of the interpretation of the respondents' responses based on CVM framework

No.	CVM components	Respondent groups	
		Local inhabitants	Visitors
1	Forms	• Neglected hydrologic and non-hydrologic infrastructures, and wall and fence around the pools as well • The decrease of vegetation number due to natural damage and demolished for physical construction	• Infrastructure and facilities to support recreational activities • The decreasing number of vegetation has reduced the site amenity
2	Processes	• The site acts as a medium of daily activities and periodic traditional events. • The change in spatial-use pattern which was affected by the open access to the main pool. • Poor maintenance & less development • The decrease of visitors number	• The site has not significantly changed over time • Slow development that neglected damage infrastructure • Waste problem
3	Relationships	• The site is part of their daily life which has created memories and familiarity • Feeling blessed for having abundance water while other villages lack of water • Future development is hopefully will improve the villagers social economic condition	• The image of the site is fresh-cool air area and as the source of high-quality water • Future development is hopefully for recreational/tourism area

4.3. Synthesis of human-landscape interaction

In this research, the human-landscape interaction can be classified into direct interactions-those with a visible impact on the site; and indirect interactions which are intangible and to a certain degree may affect the site. Direct interaction mainly related to users' need for water and space for activities of the locals and visitors. This interaction shaped functional areas in UWS such as pools, rice fields, dry-fields, and food stalls. For this case, the direct interaction had established people-place bonding for goal-support and self-regulation in the context of socio-economic functions.[13] The indirect interaction related to meanings which were embedded to the site, including emotional bounding created familiarity and memory of the site mainly by the local inhabitants. The prevailing myth, legend, and image of the site, which were perceived by locals and visitors also form indirect interaction between users and the UWS. These indirect interactions show the dimension of place attachment as affection and cognition.[13]

As already has been discussed in the physical elements analysis, improper use of space for activities was mainly caused by direct interaction of users-site. The impact of the interaction is visible through the spatial pattern and physical elements found on site. Economic and social

factors have likely driven the interaction that furthermore, have stimulated landscape changing. The economic factors, in this case, relating to water needs and space utilization for livelihood, were manifested in the form of agriculture and industry. Meanwhile, the needs for clean water for domestic use and recreational space-use became social factors. Those factors underlay the users-site interaction that subsequently, gave impact in transforming the landscape of UWS.

5. Conclusion

Based on hydrological susceptibility, which became the critical factor of UWS sustainability, the site can be categorized into the core zone, buffer zone, and utilized zone. Further analysis indicated that in connection with site utilization, people's activities was incompatible with the hydrological susceptibility zones. The analysis of local inhabitants and visitors perceptions showed that the unsuitable use of space was caused by direct interactions of users and the site. The direct interaction was reflected through the use of UWS resources, including clean water and the site occupation for functional space development. This direct interaction has driven the transformation of the site. Meanwhile, the indirect interaction created emotional bound and socio-cultural values embedded to the site through myth, legend, and image formation.

From the analysis of users-site interaction, it is apparent that economic and social factor influenced the landscape changes. The economic factor is associated with people's needs of water for agriculture and industry, in addition to the UWS site usage for diverse economic activities. The social factor derived from the needs of water for domestic use and of space to accommodate daily routine and recreation as well. It is apparent that the incorporation of analysis of physical landscape and people perception supported our understanding of human-landscape interaction and the process of how the interaction has changed the landscape in UWS.

6. References

[1] Sauer CO 1925 The morphology of landscape. *Univ California Publ Geogr* **2**:19–53
[2] Naveh Z 1995 Interactions of Landscapes and Cultures. *J Landsc Urban Plan* **32**(1): 43– 54. DOI: 10.1016/0169-2046(94)00183-4.
[3] Marcucci DJ 2000 Landscape History as a Planning Tool. *J. Landsc Urban Plan* **49**: 67–81. DOI: 10.1016/S0169-2046(00)00054-2
[4] Hennink M, Hutter I and Bailey A 2011 Qualitative Research Methods (London: Sage)
[5] Damayanti VD, Nailufar B, Putra PT, Syahadat RM, Alfian R and Leimona B 2017 Analisis Tapak Mata Air Umbulan, Pasuruan, Jawa Timur. WP 262 Bogor, Indonesia: World Agroforestry Centre (ICRAF) Southeast Asia Regional Program. DOI: http://dx.doi.org/10.5716/WP17147.PDF
[6] Stephenson J 2008 The Cultural Values Model: An Integrated Approach to Values in Landscape. *J. Landsc Urban Plan* **84**: 127-13
[7] Badan Pusat Statistik Kabupaten Pasuruan 2015 *Kecamatan Winongan dalam angka 2015* (BPS Catalogue: 1101002.3514.210)
[8] Univ of Brawijaya 2016 Soil Type Map of Pasuruan Regency
[9] Irtanto and Wahyudi H 2012 Kerjasama antar daerah dalam Pengelolaan Mata Air Umbulan Winongan Pasuruan Provinsi Jawa Timur. *J Bina Praja* **4**(2): 127–34.
[10] Subekti S 2012 Studi identifikasi kebutuhan dan potensi air baku air minum kabupaten Pasuruan. *J Momentum* **8**(2): 43-51
[11]Yogie 2015 Sejarah Mata Air Umbulan. Warta Bromo [internet]. 26 March 2015 [cited 9 Nov 2016] Available from http://www.wartabromo.com/2015/03/26/ menyingkap-sejarah-mata-air-umbulan/
[12]Rollero C and De Piccoli N 2010 Place Attachment, Identification and Environment Perception: An Empirical Study. *J. Environ Psychol* **30**(2): 198–205. DOI:10.1016/j.jenvp.2009.12.003
[13]Scannell L and Gifford R 2010 Defining place attachment: A tripartite organizing framework. *J. Environ Psychol* **30**(1): 1-10. DOI:10.1016/j.jenvp.2009.09.006