

## OPTIONS FOR ASSESSING THE SUITABILITY OF URBAN ENVIRONMENTAL ACUPUNCTURE

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### ABSTRACT

To increase their resilience to climate change, cities are looking to apply elements of urban environmental acupuncture. The essence of such measures is many smaller sites that is functioning as mitigation measures. Many of these small places then create a large overall effect. The advantage of these small-scale measures is that they can be in densely populated areas. The assessment tool described in this paper is designed for city representatives and is an aid to assess the suitability of applying a particular measure based on the parameters described. The evaluation itself then helps to decide whether the solution is suitable for a particular site or whether any of the parameters need to be adjusted to make it suitable, or whether it would be appropriate to change the proposed solution. The intention of the evaluation is not to assess the technical solution but relies primarily on the location, long-term (especially financial) sustainability and acceptance by the citizens of the city. The paper presents an example of the application of the evaluation to four sites in city Liptovský Mikuláš, describing the results and identifying parameters that can be improved to ensure the urban environmental acupuncture is accepted by citizens and thus future-proofed.

**Keywords:** *urban greenery, urban environmental acupuncture, sustainable city, urban climate resilience, adaptation strategy*

### INTRODUCTION

Since their founding, cities have been undergoing several changes that are the result of a change in the needs of their inhabitants (fortification and de-fortification, industrialization and de-industrialization, etc.) [1]. These changes are reflected in the thickening of the urban core, the consolidation of surfaces and in the expansion of cities into suburbs, which is a significant trend of the last twenty years. Cities are facing many challenges in their pursuit of sustainable development. One of the main issues is a continuous increase in cities' population. By 2050, the urban population



is projected to account for 66 % (some sources say up to 70 %) of the population, and in cities in Africa and Asia it is projected to be as high as 80 % [2]. cities today face a challenge in the form of climate change [3]. Climate changes lead to a gradual temperature rise in cities which results in more intense heat islands [4]. Climate changes also increased risk of floods [5] which is mainly associated with pluvial floods [6], that cause local damage, often unrelated to overflowing persistent water body. An increase in urban density leads to a higher risk of heat islands formation as well as a higher risk of pluvial floods due to a reduction in green unpaved areas [7].

Proper management of green spaces in the city and their well-planned structure can have a positive impact on both the reduction of heat islands and the reduction of the consequences of pluvial floods [8]. Many cities have parks and green areas over 2 hectares in size in their urban structure. However, these green sites are typically quite far from each other, and their impact is not covering the whole city area [9]. In a high-density city structure, it is rarely possible to introduce new green areas of large size such as parks, it is, therefore, necessary to seek other solutions [10]. The introduction of small green spots – “urban environmental acupuncture” (UEA) - represents such a solution. In adaptation strategies, we can find several requirements for the incorporation of green spots into the urban structure, but there are no guidelines how such application should be carried out.

- When implementing small green spots, it is necessary to address the following basic questions. Which localities are suitable for the application of urban green acupuncture?
- Which are suitable solutions?
- Which solutions are particularly suitable for a specific place?

The main motivation of the research was based on the following assumptions. Heavily urbanized environments with pressure for gradual thickening of buildings [11] use master plan that clearly defines and limits functional use of the areas. This makes it difficult to establish larger green areas that would serve as adaptation and mitigation measures within the adaptation strategy. However, smaller green spots can be placed on the plots without affecting the overall land use, which can follow the master plan. The proposed approach is part of the solution of the project SALUTE4CE. The objective of the research was to propose a procedure for evaluating potential sites, which would help city representatives in deciding on the location and the form of small green spots in the implementation of cities' adaptation strategies, master plans, strategic development plans or other documents. The end users of the procedure are cities' employees and representatives, to the needs and abilities of which the procedure is adopted and who had an opportunity to comment on its design in the professional discussions. The procedure also considers possible expectations of the public.

## **MATERIALS AND METHODS**

The basic conditions that the evaluation system must have were defined as:

- Simplicity of the model.

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- Fast application in relation to availability of the input data without lengthy and complex data gathering techniques.
- Reasonability of the proposed solutions.
- Genericity of the assessment allowing use of the procedure on a broad spectrum of various cities.

A potentially suitable place for application of small green spots “Potential Urban Environmental Acupuncture Spot” (PUEAS) would be:

- a place that is not maintained, is neglected or does not fulfil its function;
- a smaller site - ideally up to 0.2 ha but no more than 0.6 ha to allow for feasible implementation,
- a place that spoils image to its surroundings or even reduces property prices in vicinity.

### **Description of the determination method for assessment**

The objective of the research was to propose assessment of the suitability of types of solutions. The assessment should fulfil these aims:

- The evaluation is based on the relationship between the locality and the type of UEA.
- The evaluation is applicable when comparing different types of UEA for one locality as well as when assessing multiple localities for one particular type of UEA.
- The analysis of selected localities aimed to identify the parameters of evaluation and subsequently evaluate these parameters.

The assessment is based on the following parameters:

- location of PUEGAS,
- difficulty of implementing the plan according to the policies of the official body (budget rules),
- requirements for future maintenance,
- involvement of local community and investor in an implementation of the UEA idea,
- future usability of implemented plan.

The location parameter is focused on the position in the urban structure. PUEAS are more important in central parts of cities where there typically is less greenery than in the outer parts. For such central location, environmental problems are expected to be more emphasized (for example heat distribution [12]) and at the same time, even the small-scale solution might have a significant effect on situation improvement.

The parameter of difficulty of implementing of the plan according to the powers of the official body (budget rules) evaluates the already assumed type of UEA. The preparation time factor is projected in the parameter. If the expected investments are in a volume requiring the approval of the entire assembly, the preparation time is much longer than if the approval of one person is sufficient.



The complexity of maintenance of the planned intervention is reflected in the expected additional costs. A higher level of maintenance poses problems for the future sustainability of the implemented UEA spot. If the maintenance complexity is high, it can pose a risk of being neglected in the future [13].

For optimal functionality and progress of the proposed measures within the UEA in the given locality, participation and involvement of the investor of the plan, but especially the public, which will be the end users of the expected benefits, is beneficial already in the first steps even in the selection of PUEAS [14]. Evaluation questions were compiled for this parameter, which were subsequently tested by the panel of experts. The level of participation and involvement is crucial, especially when comparing suitable sites for some particular type of UEA.

Direct involvement of citizens is of course related also to the perspective of the future use of the proposed UEA measure. The unrestricted public access option is preferred.

A point system was designed for selected parameters, which was subsequently tested at 16 localities that are already PUEAS. The testing was performed in collaboration with a panel of experts. The panel of experts consisted of the SALUTE4CE project team and representatives of cities and development organizations - the panel of experts totaled to 15 people.

The individual parameters were assigned a weight based on the conclusion of the panel of experts. Metfessel allocation was applied to determine the weight (using the criteria tree). The weight of individual parameters is given in Table 1.

*Table 1. Weight of individual parameters.*

Parameter	Weight [%]
location of PUEAS	25
difficulty of implementing the plan according to the policies of the official body (budget rules)	23
requirements for maintenance	23
involvement of local community and investor in an implementation of the UEA idea	15
usability of implemented plan	14

The total value is then determined by the weighted sum of the points for the responses (equation 1).

$$\text{Total Value} = \sum (\text{Points for the response} \times \text{Weight of the question}) \quad (1)$$

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**Table 2.** Description of the characteristics for the allocation of points for each parameter.

<b>Parameter</b>	<b>Parameter value</b>	<b>Points</b>
PUEAS localization	Exposed locality in the core area of the city (compact construction area with a minimum share of greenery)	6
	Exposed locality outside the core area of the city (structurally not completely compact area, e.g. housing estate with a share of greenery)	5
	Unexposed location in the core area of the city (compact construction area with a minimum share of greenery)	4
	Unexposed locality outside the core area of the city (not completely compact area with a share of greenery)	3
	Scattered (loose) structure of the city with a predominant industrial zone	2
	Scattered (loose) settlement structure of the city with a higher proportion of greenery	1
Difficulty of implementing the plan (budget rules)	Low (in the competence of the mayor)	6
	Medium (in the competence of the city council)	4
	High (within the competence of the city assembly)	2
Requirements for maintenance	Zero maintenance - the project is "self-sufficient", no demands on staff or equipment -> no costs	6
	Low maintenance - the project is almost "self-sufficient", minimal demands on staff or equipment -> minimal costs	5
	Rather low maintenance - demands on trained staff, or. technique -> medium cost	4
	Medium maintenance - higher demands on trained personnel and equipment -> higher costs	3
	High maintenance - high demands on trained personnel and equipment -> high costs	2
	Very high maintenance - very high demands on trained personnel and equipment -> very high costs	1
Involvement of the local community and investor in the implementation of the UEA plan	The local community is interested (somehow) in improving, the investor is interested in improving conditions	6
	The local community is interested (somehow) in improving, the investor is not interested in improving conditions	3
	The local community is not interested, the investor is interested in improving conditions	3

	The local community is not interested, the investor is not interested in improving conditions	0
Usability of the implemented plan	General public - can actively use (garden)	6
	General public - can use passively (green wall on the block of flats)	4
	Limited public / closed society - can actively use (green roof)	2
	Limited public / closed society - can passively use (inaccessible atrium of a private building)	1

For research purposes, 40 sites have been selected. This set contained:

- 16 sites which were selected as “Potential urban environmental acupuncture spots” (PUEAS) by cities which already had plans for certain solution. These sites are further solved within SALUTE4CE project.
- 16 sites, which already represent small green spots – such as an existing community garden or an existing green wall. These sites have been selected by the project team as a reference for research.
- 8 sites, which have been identified by the project team as PUEAS, but they are not solved within SALUTE4CE project. They have been identified by applying defined selection criteria for PUEAS with special focus on abandoned and underused areas. These sites have been partially evaluated by the procedure

To determine the intervals of the total value (Table 3) so that the main goal of the whole research was met - the evaluation of a suitable solution for a specific PUEAS. The main 32 localities were used to determine the intervals and 8 new localities were used for testing. Information was gathered using a spreadsheet. Information was collected from investors, representatives of the city as well as from public survey among citizens.

Based on the total value, the individual solutions were divided into four intervals (four categories) as shown in Table 3.

**Table 3.** Application suitability categories proposed by UEA - distribution of the total calculated value into intervals

Interval	Evaluation of the plan:	Category
<4,34; 6,00>	UEA type is suitable for the given locality	I.
<3,54; 4,2>	UEA type is conditionally suitable for the given locality	II.
<2,60; 3,40>	UEA type can be problematic for the given locality	III.
<0,94; 2,60>	UEA type is unsuitable for the given locality	IV.

**RESULTS OF APPLICATION EVALUATION PROCEDURE**

To demonstrate the application of the assessment procedure, four sites from the town of Liptovský Mikuláš were selected.

A - Part of the front facade of the House of Culture on Hollého Street) which represents the point application of the UGA. The House of Culture is located right in the heart of the city. The locality is characterized by high heat stress, lots of paved areas and the greenery is near. Solution - Green wall

B - Courtyard in the housing estate Podbreziny delimited by Hradišská, Jeffremovská and Senická streets, in the Podbreziny housing estate. The site is located on the outskirts of the city and in terms of attractiveness it is not an exposed place. The site is characterized by temperature stress in the summer months, low functionality of the green area. Solution - New greenery, workout playground.

C - Unused school garden of the primary school and kindergarten on Demänovská Street. The site is located on the outskirts of the city with a higher presence of greenery and in terms of attendance or attractiveness is not an exposed place. In addition, this unused area is located directly on the school premises, so access of the public will be limited. Solution - orchard, garden.

D - Peace Square, is located directly in the city centre, i.e., in the exposed part in the city centre, near the shopping centre. It is characterized by thermal stress, despite numerous and costly revitalizations in the past the square does not fulfil the function of the centre, has low functionality of green areas. Solution - green passage from climbing plants.

All four sites based on their attributes are PUEAS. The point evaluation of individual parameters is given, and the final classification is shown in Table 4.

**Table 5.** Points of Parameters appropriate solution assigned to individual sites and

Parameter	A	B	C	D
PUEGAS localization	6	5	1	6
Difficulty of implementing the plan (budget rules)	4	2	6	2
Requirements for maintenance of the future	3	5	4	3
Involvement of the local community and the investor in the implementation of the UGA plan	3	6	3	3
Usability of the implemented project	4	6	2	6
Total Value	4,12	4,60	3,28	3,94
Category	II.	II	III.	II.

## CONCLUSION

From the examples given of the evaluation carried out, it can be documented that a decision on the suitability of any of the UEA solutions requires consideration of various parameters. It also gives the possibility to adjust some parameters. Applying the proposed evaluation procedure to the four sites, the following results were found. House of culture site. The green wall has been assessed as the UEA type is conditionally suitable for the given locality. There are two problem areas in the assessment. The first is the high maintenance costs, this parameter is quite difficult to work with. The occupant engagement parameter can be improved. In the recommendations for the town of Liptovský Mikuláš this information is key. The solution of the proposed for Courtyard in the housing estate was evaluated as UEA type is suitable for the given locality. For the locality- Unused school garden – result - UEA type can be problematic for the given locality. There are three key low-scoring parameters in the assessment. Location outside the central part of the town. Limited access to the school garden for the wider community. And associated public engagement. However, this locality is primarily educational in nature. The Peace Square site has been assessed as UEA type is conditionally suitable for the given locality. The issues here are problematic involvement in development plans, expensive maintenance, and little citizen involvement.

The assessment procedure developed is designed to assist in evaluating the suitability of the UEA for PUEAS. However, it is an auxiliary tool, and its purpose is to adjust the parameters if necessary, so that when the UAE is built, the city's efforts will be successful.

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