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Tuhkanen, Heidi, Cinderby, Steve [orcid.org/0000-0002-8394-2831](https://orcid.org/0000-0002-8394-2831), De Bruin, Annemarieke [orcid.org/0000-0001-8316-5975](https://orcid.org/0000-0001-8316-5975) et al. (4 more authors) (2021) Health and wellbeing in cities - Cultural contributions from urban form in the Global South. Wellbeing Space and Society. p. 1. ISSN: 2666-5581

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# Health and wellbeing in cities - Cultural contributions from urban form in the Global South context

Heidi Tuhkanen<sup>a,b,\*</sup>, Steve Cinderby<sup>c</sup>, Annemarieke de Bruin<sup>d</sup>, Anna Wikman<sup>e</sup>,  
Charllotte Adelina<sup>f</sup>, Diane Archer<sup>f</sup>, Cassilde Muhoza<sup>g</sup>

<sup>a</sup> Stockholm Environment Institute, Tallinn Centre, Tallinn 10416, Estonia

<sup>b</sup> Faculty of Biological and Environmental Sciences, University of Helsinki, 00014 Helsinki, Finland

<sup>c</sup> Stockholm Environment Institute, Department of Environment & Geography, University of York, YO10 5NG, United Kingdom

<sup>d</sup> Wageningen University and Research, Netherlands Wageningen, the Netherlands

<sup>e</sup> Centre for Interdisciplinary Methodologies (CIM), University of Warwick, United Kingdom

<sup>f</sup> Stockholm Environment Institute, Asia Centre, Bangkok, Thailand

<sup>g</sup> Stockholm Environment Institute, Africa Centre, Nairobi, Kenya

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## ABSTRACT

Urban public spaces, both natural and built, contribute to the liveability of urban spaces. Evidence shows that natural urban spaces can improve both physical and psychological wellbeing through providing cultural ecosystem services (CES), but there is a lack of evidence from Low and Middle Income Countries (LMIC). Recognising the pressures that public spaces are under in rapidly changing cities of the Global South, it is critical that research is done to strengthen the argument to maintain the availability and accessibility of these assets. This is particularly the case in secondary cities where pressures to redevelop are high due to rapidly growing populations, whilst governance and planning systems typically prioritise growth. This paper presents participatory geographic information system survey findings for two contrasting LMIC secondary cities (Nakuru, Kenya, and Udon Thani, Thailand). We explore the interlinkages between urban public spaces, CES, and residents' wellbeing. Our findings show that both natural and built areas in these two very different ecosystems are important for promoting wellbeing. Key factors that enabled or prevented the use of public spaces were convenience: proximity, affordability, and usability. The results also highlight the effects of the inequitable distribution of inviting public realm spaces across the cities and consider the impacts on spatial justice. These findings strengthen the need to promote wellbeing considerations through urban planning in rapidly changing cities to ensure their future liveability.

## Introduction

Over the upcoming decades, sustainable development will largely be a story of our transition to urban living where city environments will have to adapt to deal with a multitude of challenges. This concentration of human populations, pollution emissions and impacts (of environmental, social and economic nature) means we need to identify how to maximise the opportunities that cities offer in order to create wellbeing alongside livelihoods. This entails making cities people-centred, liveable, equitable, sociable, and enjoyable; elements central to the commitments made in the New Urban Agenda (United Nations 2017) and the UN Sustainable Development Goals (SDGs) (United Nations 2020).

Urban public realm spaces (PRS), both natural and built, contribute to the liveability of cities. Even in cities, humans are dependant on the flow of ecosystem services from nature which contribute to their wellbeing (Millennium Ecosystem Assessment 2005). Urban public spaces can enable people to connect with their environment, themselves, and each other, all of which are important components of maintaining wellbeing. Evidence shows that natural urban spaces can improve both physical and psychological wellbeing, for example, through their associations with spiritual benefits, inspiration, and places for relaxation, education or recreation (Norton et al., 2012). Psychological wellbeing, or good mental health, is then a state of wellbeing in which individuals realize their own abilities, can cope with normal life stresses, work

\* Corresponding author at: Arsenal Centre, Erika 14, 10416 Tallinn, Estonia.  
E-mail address: [heidi.tuhkanen@sei.org](mailto:heidi.tuhkanen@sei.org) (H. Tuhkanen).

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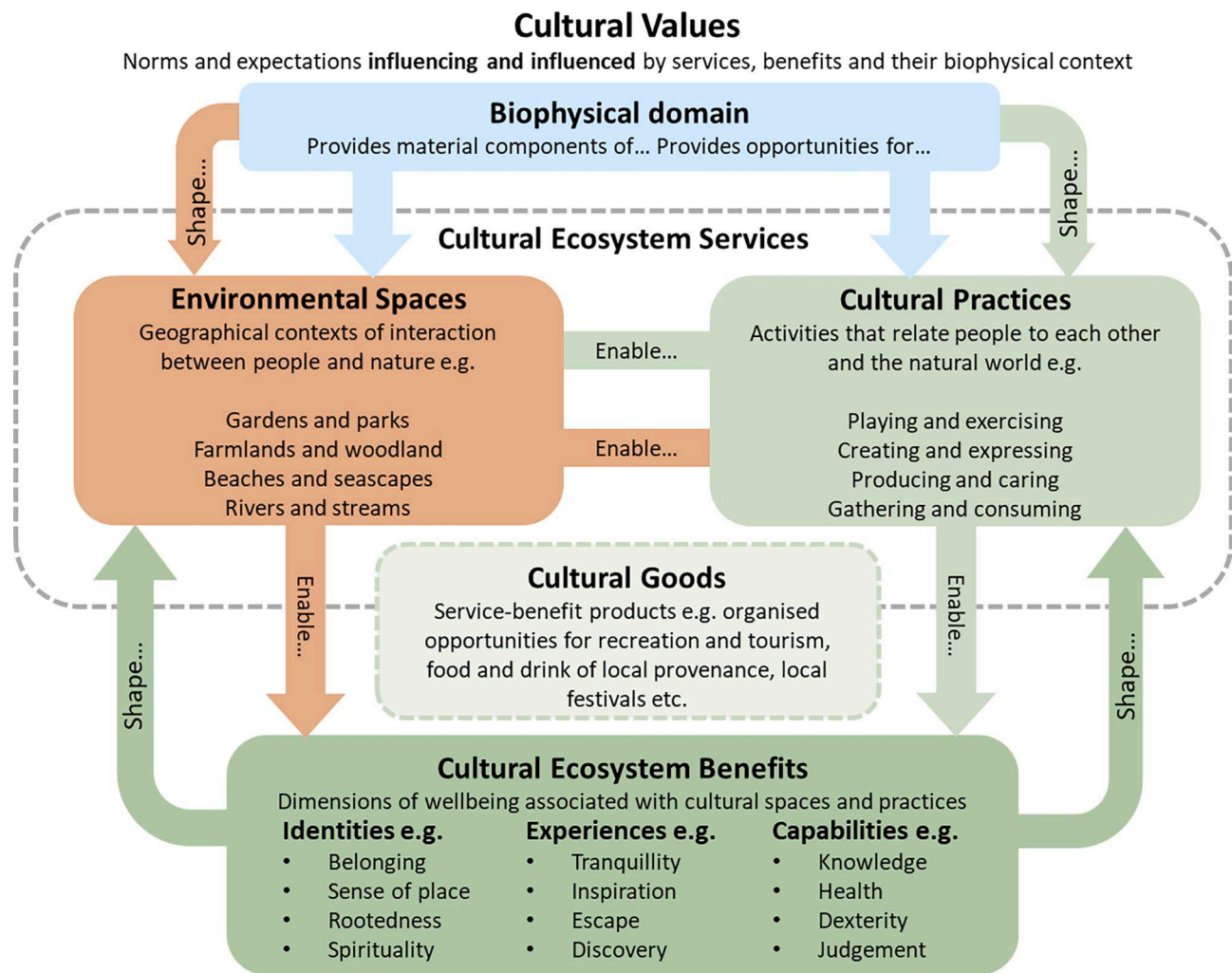


Fig. 1. CES Framework by Fish et al. (2016).

productively, and contribute to their community (Haver et al., 2015).

Evidence of the value of urban spaces to societal wellbeing has largely been derived from the Global North, with recent reviews highlighting the absence of evidence from settings in Low and Middle Income Countries (Nawrath et al., 2021; Shuvo et al., 2020; Wangai et al., 2016; Sahakian et al., 2020). Nevertheless, what we are witnessing in many rapidly changing cities of the Global South is natural and built public spaces frequently under pressure to be redeveloped to meet economic or infrastructure provision demands (Gwedla and Shackleton 2015; Gue-nat et al., 2019; Nor et al., 2021). This is particularly the case in secondary cities where development pressures are often highest due to growing populations, combined with poverty, poor infrastructure and ineffective governance structures (Cohen 2006). Another challenge is the increasing commercialisation of PRS, which reduces their accessibility (Kotsila et al., 2020). Thus, there is an urgency in further unravelling the importance of available and accessible PRS for societal wellbeing in cities in the Global South. In a recent study based on objective and subjective wellbeing, Cinderby et al., p.13 indicate that “enabling residents [in an LMIC secondary city context] to spend 2 h per week in greenspace may generate similar wellbeing benefits to those identified in European studies”.

Within the context of future climatic conditions, ignoring the benefits of well-protected and maintained public spaces on societal wellbeing in planning risks locking rapidly changing cities in the Global South into development patterns mirroring those in the Global North, where authorities are forced to retrofit green infrastructure to improve wellbeing

(Cinderby and Bagwell 2018). A better understanding of the context-specific factors and the dynamic interactions determining wellbeing in LMIC urban settings will provide insights to maximise benefits and avoid negative impacts (Haase et al., 2014). Furthermore, a planning for wellbeing lens complements and strengthens other priorities, such as climate change mitigation, pollution control and urban resilience.

To contribute to the evidence base on the value of urban spaces to societal wellbeing in LMIC settings, this paper presents findings from two contrasting LMIC secondary cities (Nakuru, Kenya, and Udon Thani, Thailand). Participatory mapping data explores the interlinkages between urban public spaces, cultural ecosystem services (CES), and resident wellbeing. We analyse this data in three ways: 1) the types of natural and built public spaces residents used for relaxing, socialising and exercise and those they found stressful; 2) the CES they experienced and their association with natural and built public spaces; 3) the factors enabling or preventing access to these spaces or those influencing wellbeing benefits. We end with recommendations on the importance of including a wellbeing focus in urban planning.

#### Urban public realm space, cultural ecosystem services and wellbeing

Urban public spaces are explicitly valued in the context of the UN SDGs, specifically target 11.7 to “provide universal access to safe, inclusive and accessible, green and public spaces, particularly for women

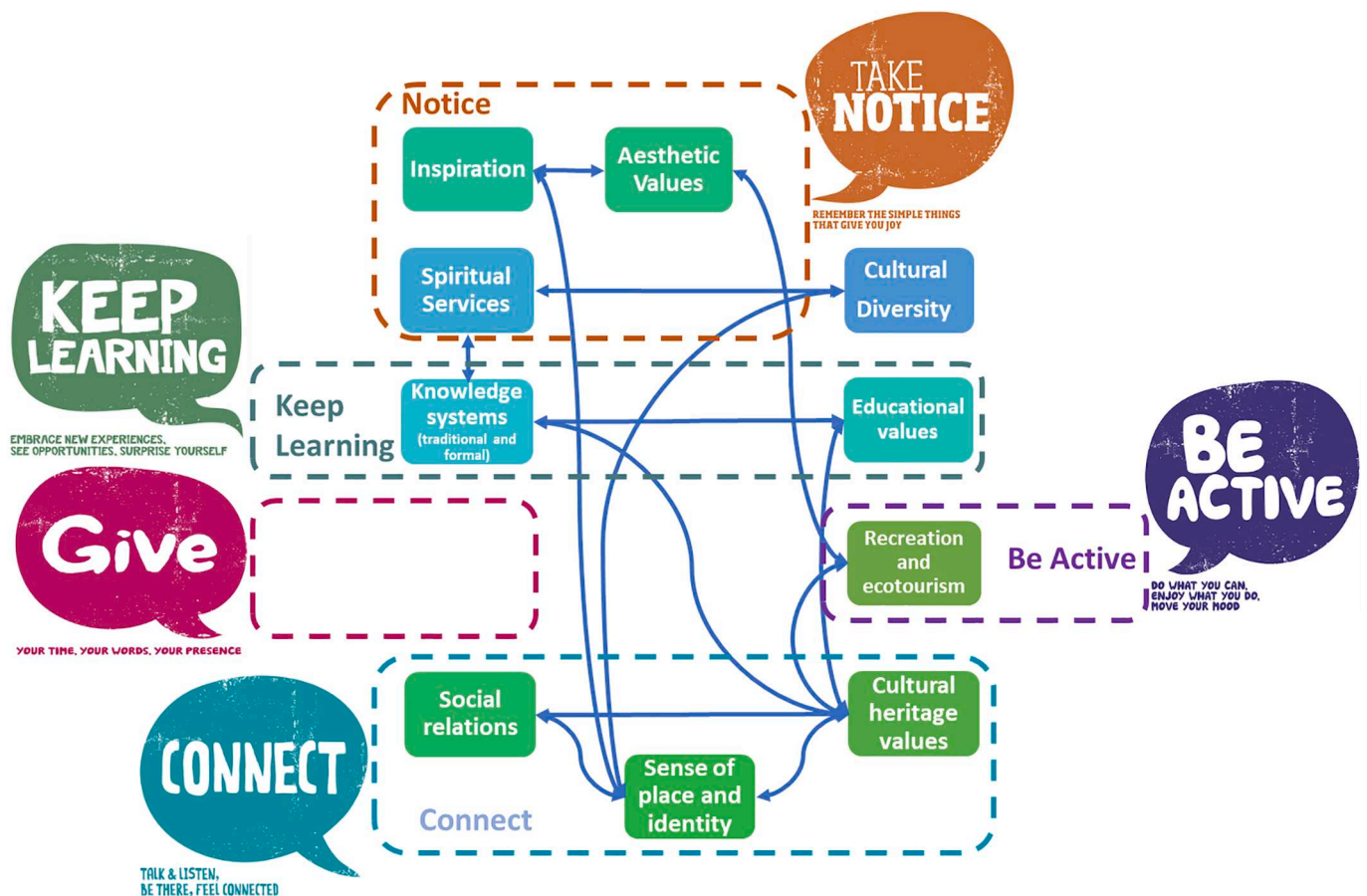


Fig. 2. Connection between dimensions of CES and their pathways to wellbeing through the Five Ways to Wellbeing (Note: the “Give” pathway does not map to specific CES but instead moderates benefits from all dimensions.)

and children, older persons and persons with disabilities” by 2030 (United Nations 2020, p.12). The definition of PRS includes physical spaces used for group or individual activities that are publicly accessible (Mehta 2014). Natural urban spaces, often referred to as urban green-spaces (UGS), have been defined as vegetated urban spaces (Taylor and Hochuli 2017); however, this definition is not globally appropriate. In relation to the Global South, the term suffers from a ‘colonial’ fetishization of green – and a lack of inclusivity of other spaces valuable within their cultural contexts. This study advocates for a wider definition under the banner of UGS and understands they include natural (brown-, green-, blue-, and barren spaces) alongside built PRS (indoor and outdoor spaces), and their combinations.

In order to better understand the value of urban public spaces, this study focuses on the cultural ecosystem services (CES). CES is one of the categories of ecosystem services identified by Millennium Ecosystem Assessment (2005), along with provisioning, regulating and supporting services. The Millennium Ecosystem Assessment was carried out to specifically “assess the consequences of ecosystem change for human well-being and to establish the scientific basis for actions needed to enhance the conservation and sustainable use of ecosystems and their contributions to human well-being” (P.V). The assessment identified multiple components of human wellbeing and linked these to the four categories of ecosystem services. In other words, ecosystem services enables us to look at the interaction between humans and their environment, whereas cultural ecosystem services (CES) helps us investigate how the environment is valued by humans; to understand how the city interacts with nature, and to understand our dependence on it for wellbeing.

CES are specifically defined as “nonmaterial benefits that people obtain from ecosystems through spiritual enrichment, cognitive

development, reflection, recreation and aesthetic experience” (Millennium Ecosystem Assessment 2005, p.40). The ten CES categories and their connection to wellbeing utilised in this study are seen in Fig. 2. In this paper we build on the relational view of CES, which recognises that they emerge from reiterative human-ecosystem interactions in which human practices shape contexts, and contexts enable human practices (Chan et al., 2012). Fish et al. (2016) provide a conceptual framework visualising these interactions through feedback loops creating various dimensions of benefits: experiences, capabilities and identities (see Fig. 1). This means that the cultural benefits created are person- and location-specific (Raudsepp-Hearne et al., 2010; Dickinson and Hobbs 2017).

Bullock et al. (2018) recognise the importance of access, infrastructure and facilities in determining the extent to which environmental spaces enable cultural practices, which is supported by usability studies (Quatrini et al., 2019; Mao et al., 2020). Extant studies have also looked at how societal groups differentially use and experience landscapes and value the resulting CES. In a pan-European context, socio-cultural variables such as migration background, language, gender, health, and occupation have been shown to influence urban CES benefits (Mäkinen and Tyrväinen 2008; Tyrväinen et al., 2014; Özgüner 2011; Riechers et al., 2018; Riechers et al., 2019; Kabisch and Haase 2014; Fischer et al., 2018). Influencing factors within the Global South are less well studied (Roy et al., 2018; Mundoli et al., 2017; Haase et al., 2014).

Wellbeing can objectively be defined in terms of quality of life indicators such as material resources (e.g. water and energy access, employment, housing) and social attributes (education, health, political voice, and social networks) (D’Acci 2011). Considering wellbeing and health in relation to the environment implies that individuals should not only live in clean and safe spaces, but also have the opportunity to live,



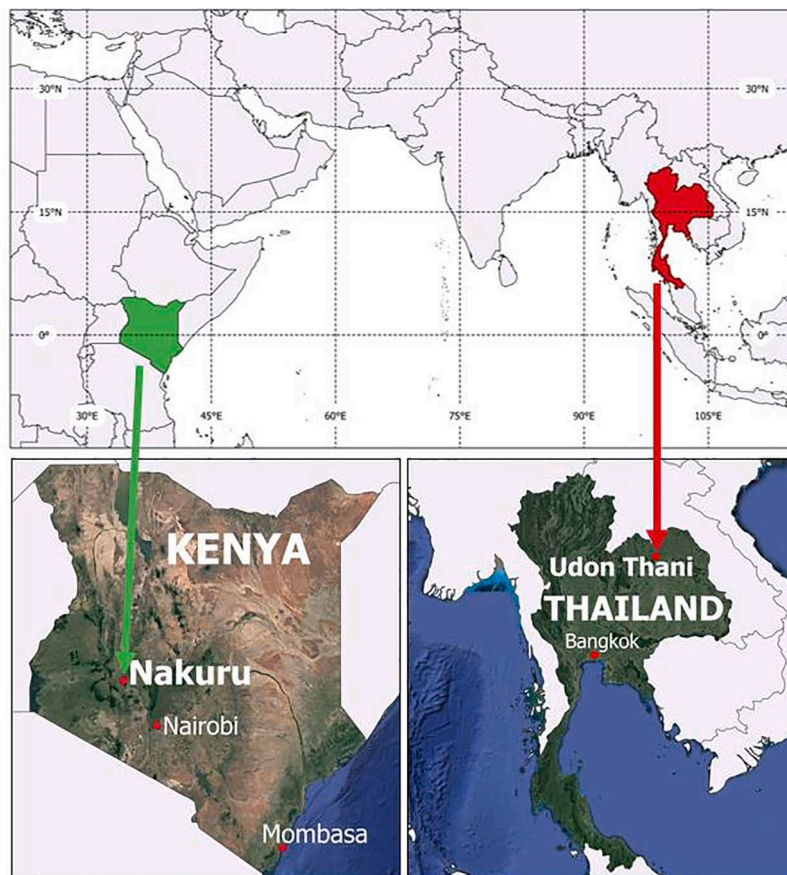


Fig. 3. Case study locations.

act and move around in health-promoting locations (EEA 2015). Subjective wellbeing emphasises people's self-evaluations, especially life satisfaction (a cognitive evaluation) and emotional state (happiness) (Western and Tomaszewski 2016). Another perspective defines wellbeing in relation to positive functioning associated with social and place relationships, coping strategies and environments (both social and physical) that empower members of society (Ryan and Deci 2001).

CES's underpinning support of security, basic material for good life, health, and good social relations (Millennium Ecosystem Assessment 2005) connects it to wellbeing, however, this connection is relatively under-researched, especially in the Global South (Pröbstl-Haider 2015). Fish et al. (2016) equates wellbeing with the CES benefits, or the three dimensions of human wellbeing that "arise from a series of cultural practices and the related cognitive, non-cognitive and embodied interactions occurring between people and a range of (culturally constructed) environmental spaces: places, localities, landscape or seascapes" (P 212). At a societal level, additional environment-wellbeing-related benefits emerge. For example, physical and mental health improvements connected with public health (Burls 2007). CES-related practices can also have social and spatial justice implications (Faehnle et al., 2014; Kabisch and Haase, 2014), and affect community stability (Riechers et al. 2016). Studies suggest that access to natural urban spaces plays a mediating role in determining these intangible societal wellbeing-related benefits (Neuvonen et al., 2007; Tyrväinen et al., 2014; Pearce et al., 2018; Faehnle et al., 2014; Kabisch and Haase 2014; Riechers et al., 2017).

A recent systematic review of cultural ecosystem services and human wellbeing has identified that many existing studies do not investigate the causal connection between CES benefits and their pathway to mental health improvements (Kosanic and Petzold 2020). Our study aims to overcome this deficit in approaches for evaluating CES by connecting

the recognised service dimensions to demonstrated causal wellbeing improvement pathways through the Five Ways to Wellbeing (5W2W) concept (Aked et al., 2008) (see Fig. 2). Participation in each element of the 5W2W has been demonstrated to yield improvements in personal subjective wellbeing, but significant gains are demonstrated when individuals undertake increasing combinations of actions (Mackay et al., 2019). Building upon Fish et al., we recognise the inter-related and interconnected nature of CES and their links to wellbeing, for example, benefits from taking notice of the spiritual or aesthetic value of a location that connects people to their environment through sense of place and shared cultural heritage.

## Methods

### Case study site selection

Two comparable but contrasting secondary cities of the Global South were selected to explore these concepts further (see Fig. 3). Nakuru is the fourth-largest city in Kenya and located in the Great Rift Valley. Nakuru had an estimated population of approximately 400,000 in 2018, which is expected to increase by 12.5% by 2022 (Nakuru Integrated Strategic Urban Development Plan). Nakuru has a mixture of built environments, including informal and unplanned settlements with an inadequate distribution of basic services such as water and sanitation. The built up area makes up almost 62% of the total area, green area makes up around 38%, while water makes up less than one percentage of the area. These are approximate values based on Normalized Difference Vegetation Index (NDVI) (see Supplementary Materials S1 for more details). Although there are some public parks and spaces in the centre of the city, most public realm spaces are unplanned and sporadic or semi-public (e. g. you need to pay a fee to enter or hold a club membership).

**Table 1**

Overview of the typology used in the qualitative coding of the comments related to the locations for exercise, relaxing and socialising and those participants found stressful. Positive (+) and negative (-) coding relates to whether the comments were positive or negative in sentiment.

| Categories                                       | +;<br>- | Short description   |
|--|---------|---|
| <b>Cultural ecosystem services</b>               |         |   |
| <b>Environmental space</b>                       | +       | Positive descriptions of “the places, localities, landscapes and seascapes in which people interact with each other and the natural environment” (Fish et al. 2016, p.212), including infrastructure and facilities (Bullock et al. 2018)   |
|  | -       | Negative descriptions of “the places, localities, landscapes and seascapes in which people interact with each other and the natural environment” (Fish et al. 2016, p.212), including infrastructure and facilities (Bullock et al. 2018)   |
| <b>Cultural practice</b>                         | +       | Positive descriptions of “expressive, symbolic and interpretive interactions between people and the natural environment;” (Fish et al. 2016, p.212)   |
|  | -       | Negative descriptions of “expressive, symbolic and interpretive interactions between people and the natural environment;” (Fish et al. 2016, p.212)   |
| <b>Cultural goods</b>                            |         | Service-benefit products (Fish et al. 2016) on the border of cultural ecosystem services and benefits   |
| <b>Cultural goods</b>                            |         | “The interactions between values, services and benefits. Sometimes amenable to market transactions, creating cultural goods that can be exchanged (but not always, in monetary terms)” (Fish et al. 2016, p.212)  |
| <b>Cultural ecosystem benefits / disbenefits</b> | +/-     | Dimensions of wellbeing associated with cultural spaces and practices (Fish et al. 2016), both negative and positive  |
| <b>Capability</b>                                | +       | The way in which environments “shape individual and social capacities [in a positive way] to understand and do things”, (Fish et al. 2016, p.213)   |
|  | -       | Human capacities hindered by experiences or emotions generated by the environment. (Fish et al. 2016)   |
| <b>Experience</b>                                | +       | “The way ecological phenomena are encountered and understood through [positively perceived] events. These are felt mentally or physically...” (Fish et al. 2016, p.213)   |
|  | -       | “The way ecological phenomena are encountered and understood through [negatively perceived] events. These are felt mentally or physically...” (Fish et al. 2016, p.213)   |
| <b>Identity</b>                                  | +/-     | “Ecosystems that are replete with [positive] cultural meanings through which people understand themselves and their relationship to the world around them” (Fish et al. 2016, p.213) “Ecosystems that are replete with [negative] cultural meanings through which people understand themselves and their relationship to the world around them” (Fish et al. 2016, p.213) |
| <b>Other</b>                                     |         |   |
| <b>Co-benefit</b>                                |         | Reasons for using the space related to ecosystem services which were not cultural ecosystem services (e.g. regulatory services such as shade). These responses were also when relevant coded in other categories, such as “environmental space” or “cultural practice”.   |
| <b>Convenience</b>                               |         | Reasons for using the space related to proximity, affordability, and access.  |

Furthermore, a fenced off Lake Nakuru National Park, which is accessible for a fee, lies immediately to the south of the city. Nakuru’s rapid growth is putting development pressure on the public spaces and water, soil and air pollution is threatening the quality and thus safe accessibility to these spaces. Nakuru has a temperate climate and has two rainy seasons per year. The city already faces droughts and flooding, and residents also report experiencing landslides, rainstorms, etc. Nakuru County is projected to face increases in the intensity and frequency of the hazards already affecting the area, including floods and droughts and increasing temperatures (GIZ 2021). Nakuru County is in the process of developing a Sustainable Energy Access and Climate Action Plan (SEACAP) which also covers the city.

Udon Thani in Northeast Thailand is a smaller city of 130,000 residents facing rapid development due to its strategic location near the Lao border. The municipality is an economic, trading and transport centre linking to neighbouring countries. Udon Thani is surrounded by a ring road and has an international airport and railway station. Through its Udon Charter for 2029, the city has committed to becoming a green with a focus on meetings, conventions and exhibitions. It seeks to have a walkable urban core and policy objectives include investing in green transport, green infrastructure encompassing parks, public spaces and affordable housing. Based on NDVI calculations, Udon Thani’s area is split between built area, green area and blue area (water) very similarly to Nakuru. Built up area makes up almost 63% of the total area, green area makes up around 36%, while water makes up less than one percentage of the area (see Supplementary Materials S1 for more details). The city has a tropical savanna climate with monsoons. Udon Thani is exposed to both flooding and drought and is heavily reliant on one reservoir for its water supply. Climate change is projected to increase the severity of such climate related hazards. Urbanisation has made the situation worse, but the city has engaged in international projects to build capacity relating to water management and climate resilience (ISET et al. 2014).

#### Recruitment and data collection

Data collection and analysis (Fig. 5) comprised three key stages. Within each city, surveys were carried out in several neighbourhoods which represented a cross-section of local environmental, social and economic conditions ranging from central to suburban locations, including fully to partially serviced areas in terms of public utilities (See Supplementary Materials S1). The survey was carried out in eight neighbourhoods in Udon Thani and six in Nakuru. In Udon Thani, the neighbourhoods were identified in collaboration with local partners, including city officials and local facilitators set up a stand and invited passers-by to participate. In Nakuru, neighbourhoods were identified with local partners and research assistance (facilitators) and facilitators approached people directly and then placed the map on the ground.

An on-street survey was deployed utilising a rapid appraisal mapping methodology (Cinderby 2010) collecting individuals responses to structured queries. The facilitators conducted a purposive gender-balanced sample of approximately 400 participants (See Supplementary Materials S2). Following the framework of Fish et al. (2016), the survey was structured around three general cultural activities (exercising, socialising, and relaxing), as well as identifying stressful spaces. Respondents mapped on an A0 satellite image of the neighbourhood the locations of their favourite space for each activity, as well as the most stressful place. Participants were encouraged to choose PRS, but if they did not utilise any PRS, they could choose a private space. After placing a location sticker, respondents were asked to explain their choices. This approach generated both spatial and qualitative data (abridged by the facilitators on the recording sheets). Before the facilitators engaged in data collection, the rationale and key terms of the study were thoroughly described and discussed. In both case studies, most people participating responded to the question in their own local language, though great care was taken to translate terms ‘properly’,

**Table 2**

Overview of the highest ranked location type by activity in each city. Minor locations (less than 1–2% of responses) are excluded.

| Top Ranked Locations In Each Category (Totalling >85%) | Udon Thani  | Nakuru   |
|--|---|--|
| <b>Exercise</b>  | Lakeside (65%)<br>Neighbourhood (18%)<br><br>Community Meeting Centre / Club (6%)<br>Gym (5%)   | Roadsides (75%)<br>Neighbourhood (5%)<br>Field/Open Space (5%)<br>Park (3%)  |
| <b>Relaxing</b>  | Lakeside (53%)<br>Shops/Mall (17%)<br><br>Place of Worship (12%)<br>Neighbourhood (5%)<br>Park (4%)   | Park (37%)<br>Hotel/Restaurant (17%)<br>Place of Worship (12%)<br>Neighbourhood (10%)<br>Pub (7%)<br>Field/Open Space (5%) |
| <b>Socialising</b>                                     | Hotel/Restaurant (19%)<br><br>Shops / Mall (17%)<br>Neighbourhood (14%)<br>Place of Worship (13%)<br>Community Meeting Centre/Club (9%)<br>Lakeside (9%)<br>Market (6%) | Place of Worship (26%)<br>Neighbourhood (23%)<br>Hotel/Restaurant (18%)<br>Park (9%)<br>Bar (9%)<br><br>Shops / Mall (5%)  |
| <b>Stressful</b>                                       | Roadsides (73%)<br><br>Neighbourhood (14%)  | Neighbourhood (65%)<br>Bus/Railway Station (11%)<br>Roadsides (8%)<br>Market (8%)  |

taking into account cultural differences.

In Udon Thani, data collection was carried out in December and January 2018, which is the ‘cool season’, while in Nakuru, data collection was carried out in October to November 2018, just before the wet season when the climate is comparably cool. In both cases, it is the time when people might be more likely to spend time outdoors.

### Data analysis

#### Spatial analysis

Spatial locations were digitised with centre points buffered to the approximate width of the sticker as a way of overcoming issues of positional accuracy in the digitisation process. To understand how environmental factors influenced people’s choice of locations, we calculated the distance of these buffers a road network layer and assessed their relative greenness from NDVI satellite images showing average green reflectance across the year before the survey occurred. At sticker hotspot locations Google Streetview images were used to help the researchers reflect on the comments made and to aid assessment of local conditions and quality of the spaces (examples are included in Supplementary Materials, S4).

#### Location coding

Based on the description and comment, PRS were extracted from all identified locations and coded as either built or natural spaces. For this analysis, spaces that were not public realm (PRS) were excluded. The classification of built and natural is fuzzy, as built spaces often incorporate some vegetation and many natural spaces include built infrastructure such as paths, fountains or exercise equipment. To facilitate

the analysis only clearly identifiable greenspaces (parks, sports fields etc.) were coded as natural; all other places were classified as built.

#### CES coding

The comments indicating why participants choose particular locations were coded in excel according to a typology created from the main components of the Fish et al. (2016) and (Bullock et al. (2018) frameworks. (See Table 1). The CES coding was based on a reiterative process where we thoroughly appraised similarities and discrepancies between the two case studies throughout the process to ensure a coherent and representative coding of the comments. In this process, two codes (convenience and co-benefit) emerged from the data to describe the additional justifications for using that location for the named activities. The coding was performed using Microsoft Excel.

### Results

#### Spatial analysis

Assessing the association of cultural activities and stressful locations spatially reveals the nuances of the relationship with quality of places. The hot spot maps of positive (exercise, relaxing and socialising) activities and negative (stressful) spatial locations reveals some emergent themes for the two cities (See Fig. 6 and Fig. 7). In Udon Thani, positive spaces were dominated by green-blue locations in every neighbourhood and included valued amenity infrastructure (such as public parks). While only half the participants mapped a stressful location (See Supplementary Materials S3), those identified are concentrated along the road network and are also less green (See Fig. 6 and Fig. 7) See Supplementary Materials S5). There is a statistically significant difference in the greenness and distance to roads by neighbourhood (see Supplementary Materials S6 Tables 6 and 9 for correlations). In contrast, relaxing and exercise locations in Udon Thani are located in green areas, and significantly more green areas than the socialising places. Analysis of green-blue spaces (urban lakeside parks) specifically reveals that they are utilised primarily for exercise (26% of total exercise locations).

In Nakuru, mapped activity locations are more diffuse across neighbourhoods indicating a lack of a single preferred public realm space, with the exception of a larger park in the Central Business District, with clear positive contributions and a greater diversity of spaces. Stressful locations are concentrated at key shared urban infrastructure such as bus-interchanges, market places and social clubs, suggesting that the interaction of the physical quality and nature of other peoples’ behaviours could be contributing to negative perceptions. Also, in one of our semi-informal neighbourhoods, stressful locations are co-located with the city dumpsite. Additional spatial and statistical analysis confirms that cultural activities in the semi-informal settlements and one of our inner-city neighbourhoods take place closer to roads than other locations (Fig. 6 and Supplementary Materials S8 Tables 7 and 8). The semi-informal settlements also have the lowest amounts of greenery and lack of public spaces. In contrast to Udon Thani, places used for social activities are significantly closer to roads than the measurements calculated for other activities. However, places used for socialising and exercise are also significantly greener than those used for relaxation and those that are stressful.

#### Location coding

The results of coding the primary locations associated with our specific cultural practices demonstrate that these are linked to different types of places, categorised as built or natural. In Udon Thani, natural spaces were critical to exercise (66% of participant responses) and relaxing (61%) (see Fig. 8). Examples of natural spaces to exercise and relax included the lakeside and park (see Table 2). A majority of the favourite places for socialising were built spaces, including hotels and restaurants, shops and malls, the home neighbourhood and places of



worship, etc. Stressful places were universally identified as built spaces categorised as roadsides or the neighbourhood.

In Nakuru, favourite places for exercising and socialising were dominated by built spaces, while a majority of relaxing places were natural (see Fig. 8). People overwhelmingly exercised by the roads, but many specified that they used the roadsides during times of low traffic or to travel from one place to another. The natural spaces included parks (exercise, relaxing and socialising) and fields/open spaces (exercising and relaxing) (see Table 2). It should be noted that only one Nakuru resident also mentioned the river, indicating the absence of accessible and unpolluted blue spaces. However, the division of favourite places for relaxation was more evenly split between built and natural than other categories, with 41% and 59%, respectively. Ninety-nine percent of stressful areas were built spaces, and similarly to Udon, these included neighbourhoods and roadsides, but also other shared infrastructures.

#### Neighbourhood scale analysis

In Nakuru, there were statistically significant associations between neighbourhoods and the differential use of spaces for relaxation, exercise and socialising. In relation to relaxation ( $\chi^2(5) = 109.71$ ,  $p < .00005$ ), most neighbourhoods report greater use of built spaces, apart from the CBD where there is much higher use of natural spaces for relaxation, and to a much lesser extent, Free Area. These two exceptions are related to access; the CBD has a high provision of parks, whilst Free Area is peri-urban, with a higher availability of natural spaces, although these tend to be semi-arid (or brown) according to the NDVI data. Built environments dominate exercise spaces in all neighbourhoods ( $\chi^2(5) = 18.953$ ,  $p < .0002$ ), except for Free Area, where 27% of exercise is in natural spaces compared to the citywide average of only 9%. There is a significant association between gender and use spaces for exercise ( $\chi^2(2) = 6.354$ ,  $p < .042$ ). Exercise is skewed towards built spaces for both genders (94% for women; 86% for men). Most socialising spaces are built (91%) ( $\chi^2(5) = 65.76$ ,  $p < .00005$ ) except for in the CBD where 34% of socialising occurs in natural spaces.

In Udon Thani, four of the eight neighbourhoods are heavily biased towards relaxation in natural spaces ( $\chi^2(7) = 22.28$ ,  $p < .0002$ ) (with a minimum of 64% of these activities in natural spaces). Conversely, four neighbourhoods have more balanced use of space, with an approximate 50:50 split between use of built or natural spaces. These neighbourhoods are inner city locations or those neighbourhoods with less provision of urban greenspaces (e.g. Thong Yai which has less greenery according to the NDVI data). Meanwhile, in Udon Thani, there was a statistically significant association between neighbourhoods, relaxation, exercise and built-natural spaces. Four of the eight neighbourhoods' relaxation activities are heavily biased towards natural spaces. Conversely, four neighbourhoods have a more balanced use of built and natural space. These neighbourhoods are inner-city locations or those neighbourhoods with less provision of urban green spaces. For exercise, there is a skew towards natural spaces, however, for three neighbourhoods it is balanced, indicating that built spaces can be important in some contexts, such as mixed residential and commercial areas, as well as the suburbs.

In Udon Thani (in contrast to Nakuru where gender was a differentiating factor), there is also a significant association between age, relaxation, exercise and built-natural environments. Four of the eight neighbourhoods are heavily biased towards relaxation ( $\chi^2(7) = 22.28$ ,  $p < .0002$ ) in natural spaces (with a minimum of 64% of these activities in natural spaces). Conversely, four neighbourhoods have more balanced use of space, with an approximate 50:50 split between use of built or natural spaces. These neighbourhoods are inner city locations or those neighbourhoods with less provision of urban greenspaces (e.g. Thong Yai which has less greenery according to the NDVI data). There is a significant association between age and the use of built or natural spaces for relaxation ( $\chi^2(4) = 17.50$ ,  $p < .002$ ). For younger people (less than 61 years), relaxation in natural spaces dominates (mean 63%); conversely, for the older people, built facilities become critical, with

62% of the respondents identifying these types of locations. For exercise, ( $\chi^2(7) = 40.91$ ,  $p < .00005$ ), there is a skew towards exercising in natural spaces. However, for three neighbourhoods, there is a mean split of Built 48:52 Natural, indicating built spaces are also important for some locations. These include the mixed-use Po Thong neighbourhood and the suburban Baan Muang. In relation to age, ( $\chi^2(4) = 67.95$ ,  $p < .0005$ ), a similar pattern emerges, with built environments becoming increasingly important for exercise as residents age. 80% of 18–45 year olds exercise in natural spaces; for 46–60 year olds, this drops to 49%; and on average, over 61 year olds undertake 61% of their exercise in built spaces.

#### Cultural ecosystem services assessment

In both Nakuru and Udon Thani, respondents' justifications for choosing locations covered a variety of factors including a description or attributes of the space, what they did there, how they experienced the place, and whether it is convenient; and in terms of the stressful (negative experience) areas, the behaviour and activities of others or negative aspects of the place itself. In both cities, but primarily in Udon Thani, benefits from shade and cooling were reflected more in responses referring to natural areas. In both Nakuru and Udon Thani, almost all negative comments related to built space rather than natural space (see Fig. 9 and Fig. 10).

Confirming the spatial analysis, both built and natural areas provide locations for selected activities and were thus a source of positive CES and Cultural Ecosystem Benefits and their components. As Nakuru's positive responses reflected more locations in built spaces than Udon Thani's focus on natural space, Nakuru's cultural services also flowed more from these man-made spaces. However, there were differences in why people used the spaces – both built and natural (comparing Fig. 11 and Fig. 12). In Nakuru, the main reason that people selected locations was convenience (Fig. 9), followed by how or what they experienced (experiences or cultural practices), and descriptions of the environmental space. Fewer respondent comments were coded as co-benefits, cultural capabilities, or cultural goods; cultural identity was mentioned by only a few. In Udon Thani, most responses reflected on the description of the space (environmental space) and activities taking place (cultural practice). Convenience and cultural experience were mentioned by many people, but much less often than in Nakuru. Co-benefits, cultural goods and cultural capabilities were mentioned by very few respondents.

#### Stressful places

One of the most significant differences between the cities was the selection of "most stressful location". In Udon Thani, the majority were related to traffic congestion on the road network (73%). Other reasons included crowded and congested places and troublesome dogs. In Nakuru, 65% of stressful comments were associated with crime and insecurity in respondent's neighbourhoods, followed by issues around communal infrastructure (transport interchanges, dumpsite, and markets) (19%). For example, in Nakuru, people found the dumpsite stressful because of the smell, improper waste disposal, flies, and potential impacts on health. Other comments covered issues such as theft, traffic, congestion, dirty and unhygienic areas (the market, and neighbourhood), idleness by youth and bandits. These types of activities or practices created the experience of insecurity. For the most part, natural areas were not associated with stress in either place. However, in Nakuru, there were a few mentions of insecurity in natural areas linked to unemployed youth's indulging in theft.

#### Favourite places for exercising, relaxing and socialising

In Nakuru, although both built and natural spaces were selected as favourite due to shared attributes such as spaciousness, shade, quiet and cool, natural spaces were also described in terms of their landscape attributes, as well as facilities and services (see Fig. 11). In the built



environment, infrastructure included paved footpaths, lighting, security, and equipment.

While singing, engaging with specific community groups, and education were strictly associated with favourite built spaces, street preaching and watching animals were likewise only reported in favourite natural spaces. Activities that took place both in built and natural spaces included meeting and talking with others, recreation, watching sports, eating and drinking, spiritual activities, as well as walking. In terms of wellbeing related benefits, both built and natural environments enabled mental and psychological relief (see Fig. 11). It should be noted that spiritual activities and their resulting experiences were difficult to divide between the practice and experience categories. They were mentioned in relation to both built and natural spaces. Identity-related benefits include “freedom to be yourself”, identification with specific peer groups (people originating from a specific area in Kenya; members of the same faith, family, or social class), and the association between the space and a specific group of users (e.g. playgrounds and youth). Experiences associated with natural spaces only include being comfortable, safe and secure, privacy, serenity, fun, escaping boredom, and being healthy. Activities in natural spaces were associated with capabilities such as communication and improved productivity. Improved health was a capability associated with both natural and built spaces.

In Udon Thani, both built and natural spaces were identified due to their provision of shade or cool (air-conditioned) air. Descriptions of the environmental space in natural spaces included amenities, facilities and services (e.g. paths and playgrounds) (See Fig. 12). In the built spaces, festivals and events were mentioned as cultural goods, while in the natural spaces, only organised exercise activities were mentioned. The main cultural practices included listening to music, praying, chanting, making merit, walking meditations, partying, gardening, and selling goods. Activities associated with favourite natural spaces included various forms of individual and group exercise and sports, as well as activities related to music, interacting with animals, and enjoying the landscape. Activities that were found in both natural and built areas included meeting others, relaxing, eating and drinking, shopping, and a more limited number of exercise-related activities (walking and cycling). In terms of wellbeing related benefits, shared experiences included peace, being comfortable, and happiness. Only natural areas were associated with experiencing a pleasant atmosphere, aesthetic views, as well as stress-release. Comments referring to cultural identities related to the affiliation of certain spaces with friends and social life. No capabilities were mentioned in either type of space.

Convenience was a major factor in both cities for choosing their favourite places for all three activities in both built and natural spaces. For both cities, this covered the proximity to home, work, and friends. In Nakuru, affordability (or free access) was also repeatedly mentioned.

In both cities, our measured CES results can be mapped onto varying components of the 5W2W framework to explain the pathways to wellbeing benefits. Built spaces were typically associated with social relations and belonging to a particular group associated with a sense of identity. These dimensions of CES map onto the ‘Connect’ pathway to wellbeing. Natural spaces, meanwhile, offered a wider range of affordances to contribute to wellbeing. We identified aspects of aesthetic appreciation and spiritual benefit linked to ‘Take Notice’; opportunities for exercise related to ‘Be Active’; and places to meet and socialise building on the ‘Connect’ pathway.

## Discussion

### *Types of spaces and use*

Our findings show that both natural and built areas are important spaces for socialising, relaxing and exercising activities. This indicates that wellbeing related benefits are also derived from time spent in both types of areas. People preferred relaxing in natural spaces and

socialising in built spaces, many of which were commercial. The latter finding supports van Melik and Pijper’s (2017, p.299) claim that commercial spaces can serve as “meaningful spaces of encounter.” However, preferences for exercising location types differed between the two areas. In Udon Thani, residents preferred to exercise by the lakeside park areas, while Nakuru residents preferred built roadside spaces, partly due to the lack of alternative PRS especially in lower income areas. Our findings also indicate that in both cities, participants found essential communal infrastructure, such as markets and bus stations, stressful due to the activities taking place there as well as characteristics of the space itself.

While both cities had blue-green spaces, these areas were only highlighted as a favourite place in Udon Thani. No water-specific activities were mentioned, but this can be explained by the fact that fishing and swimming are banned in these lakes. In Nakuru, lack of access to Lake Nakuru National Park and river pollution preclude many activities typical in other blue-green settings. These issues are barriers for these spaces supporting wellbeing.

Our data also suggests that whilst some locations support the wellbeing of specific residents through enabling specific activities, they are also problematic or stressful for others, detracting from their wellbeing. For example, in Udon Thani, one mixed-use commercial and residential neighbourhood was identified as stressful, but also associated with positive activities. This reflects peoples’ contradictory relationships to public space with some attracted to the hustle and bustle of urban life that others find too chaotic (Cattell et al., 2008). According to Lopez et al. (2020), the importance of having public spaces which respond to differentiated community needs has been highlighted during COVID-19. Places of mixed positive and negative associations could be further researched to explore whether they could be modified to support multiple needs. For example, roadsides were identified as stressful in both cities, but also explicitly enabled exercise in Nakuru. Research could help identify the attributes enabling exercise (shade, lighting, quiet, location, etc.), and whether these could be enhanced, while also paying attention to the mitigation of potential health impacts that are associated with roadsides (traffic safety, air pollution, etc.).

There was no identifiable difference in gender-related preferences between built or natural spaces in either city. In Nakuru, built spaces were preferred for exercise regardless of gender, perhaps because people exercise along the roadsides. In Udon Thani, both men and women preferred natural spaces. The lack of influence of gender on preference between built and natural space is supported by Tarbuck (2021), whose further analysis indicates that gender and age may, however, influence some motivations for location selection. For example, in Nakuru, men tended to select their location based on their intentions to engage with others, while women were seeking peace and quiet. In contrast, in Udon Thani, women mentioned engaging with others more than men, but only in the context of outdoor exercise. (Tarbuck 2021). This supports Cattell et al.’s conclusions which found that “people will need a variety of spaces within an area to meet a range of everyday needs, spaces to linger as well as spaces of transit; spaces which bring people together and spaces for escape” (2008, p.556). In Nakuru, the fact that different motivations led to the same preferences between built versus natural could stem from the lack of availability of natural space. In Udon Thani, the preference for natural over built may be due to the availability.

Whilst previous literature recognises issues of crime in natural spaces (Juntti et al., 2021) with specific implications for women (Paul and Nagendra 2017), this is not strongly supported by our findings. A recent review (Shepley et al., 2019) indicates that urban greenspace could have a crime-reducing effect, which might partly explain our findings. However, more research is needed to study this interlinkage as again our findings did indicate some issues of theft in Nakuru’s parks. Personal safety related stress was overwhelmingly, however, linked with the built space.

In Udon Thani, age played a role in preferences for both relaxation and exercising spaces. This finding might be explained by the city’s increasingly ageing population and their needs for facilities that are

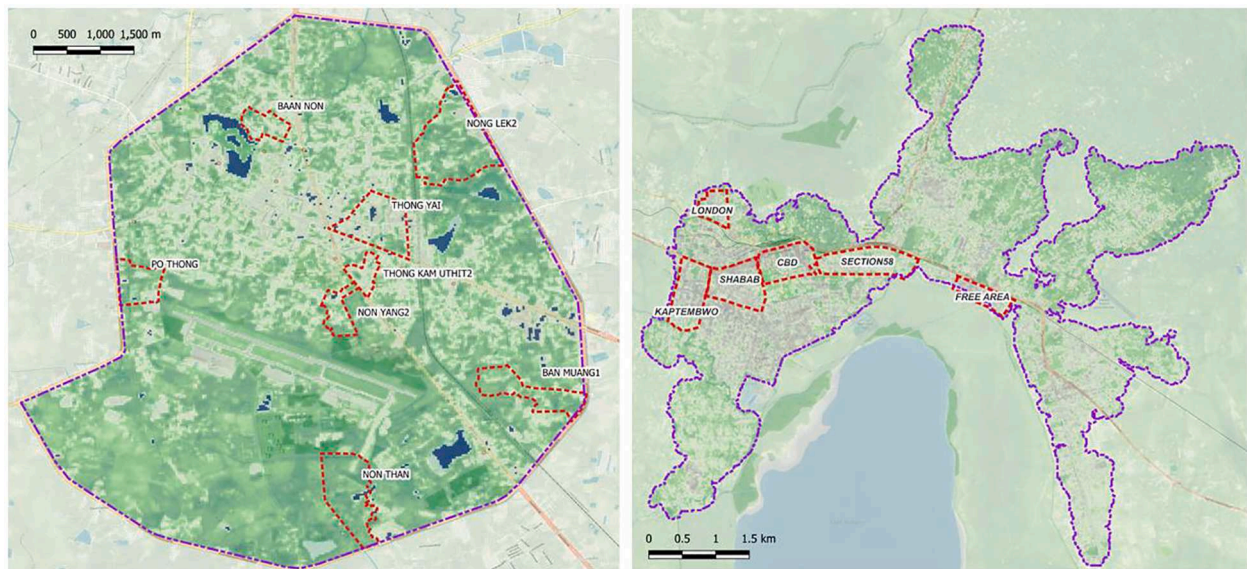


Fig. 4. The case study areas (Udon Thani on the left, Nakuru on the right) with the purple border denoting the urban extent.

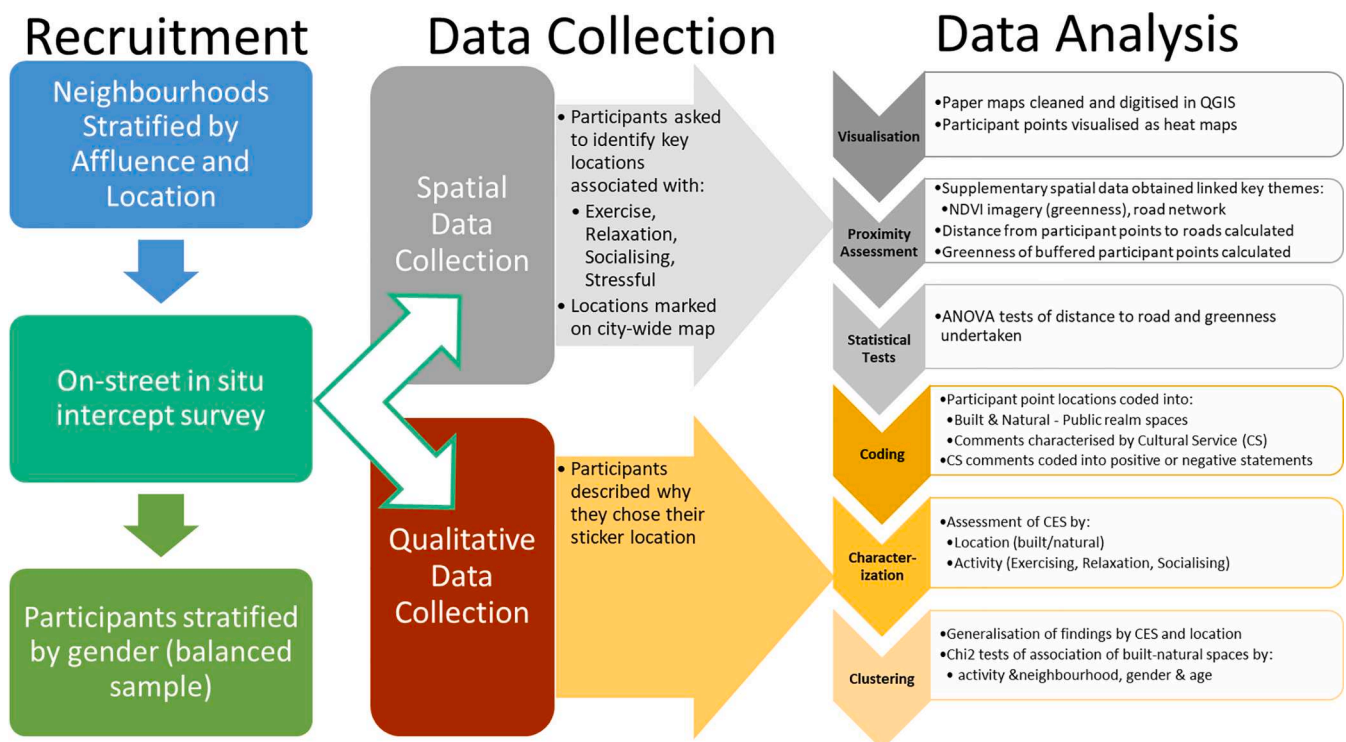


Fig. 5. Flow chart of the data collection method.

more typically found in built environments (Adlakha et al., 2021). The sample in Nakuru was slightly younger, with 65% participants aged between 18 and 45 years compared to 50% in Udon Thani.

We recognise that the timing of the study could affect the responses related to use of space, though care was taken to situate the study during the seasons which were most conducive to outdoor use, and the questions related to activities in general rather than current activities. Future studies could be conducted during hotter and wetter time periods to identify the influence of seasons on use of space. We imagine that in such times, the need for shade and cooling might be even higher.

#### Cultural services provided by public spaces

Analysing our results against the CES frameworks showed a concentration around certain CES categories and their experiences. The lack of responses in other CES categories (see *Millenium Ecosystem Assessment 2005*) and their associated identities, experiences and capabilities are likely to stem from our focus on certain activities. Our framing did not sufficiently encourage identification of wellbeing benefits related to cultural diversity, knowledge systems, educational values, sense of place and identity, inspiration and cultural heritage values. To more fully



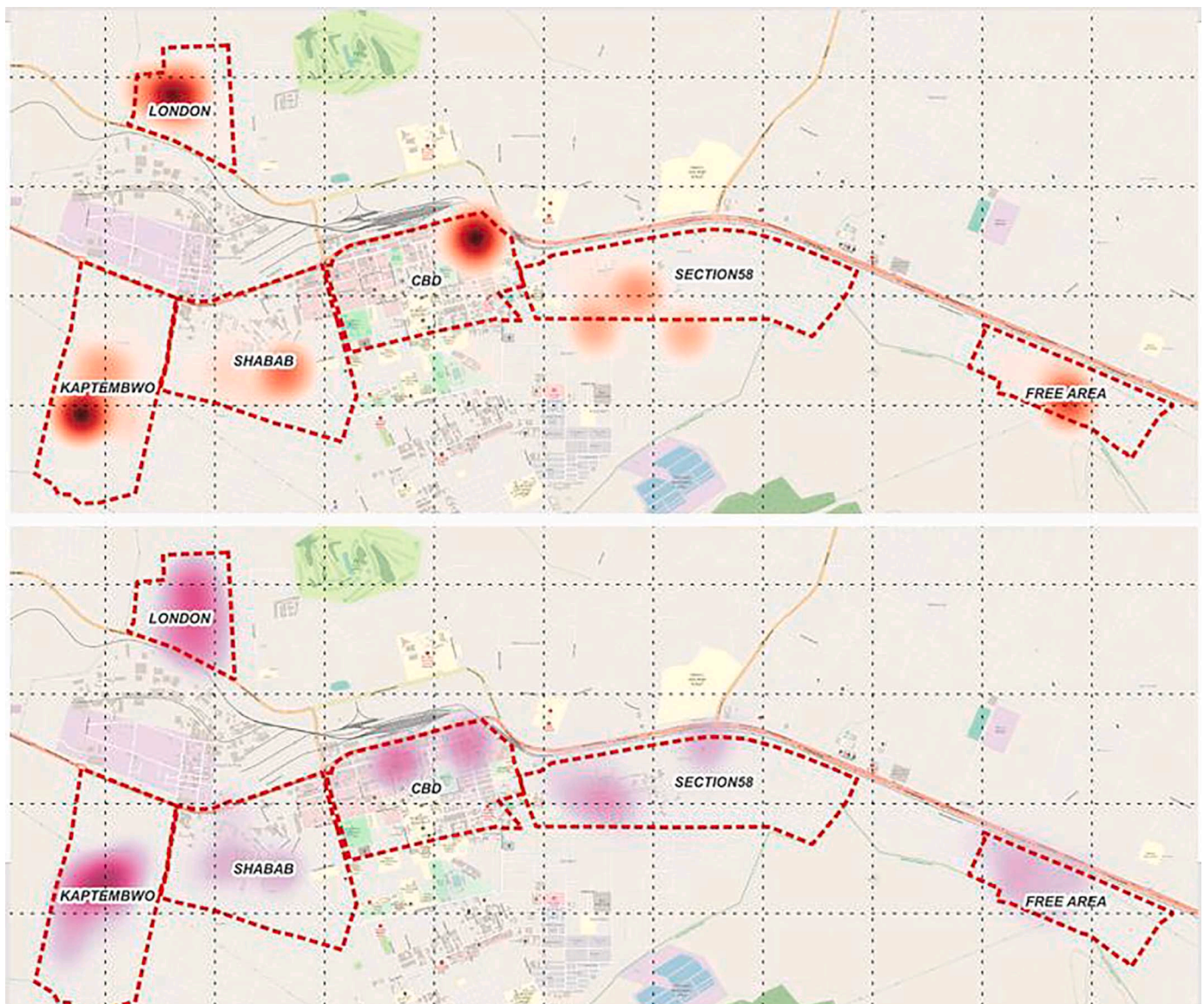


Fig. 6. Hot spot maps for Nakuru showing concentrations of stressful (top) and positive - relaxing, socialising and exercise (below) locations.

capture these types of CES, mapping related questions could be expanded to include the identification of key places for learning or connecting to heritage.

In terms of the types of goods and wellbeing related benefits, as categorised by Fish et al. (2016), our study captured more experiences than capabilities or identities. Identities-related benefits mainly revolved around association with certain peer groups (youth, faith, social class, and friends); capabilities-related benefits were ones enhancing everyday life, such as communication, productivity, and health; and experience benefits related to mental wellbeing (satisfaction, calming, etc.) and safety (secure, private). Furthermore, cultural goods were only mentioned in terms of regularly organised activities related to sports, exercise or the temple. The identified cultural practices and wellbeing benefits related to built spaces contributed to the 'Connect' pathway to wellbeing, while natural spaces contributed to a wider range of pathways ('Take Notice', 'Be Active', and 'Connect').

To better capture identities and capabilities related benefits in future studies, prompting questions could be used, e.g. "What capabilities were discovered, learned or practiced there?" or "Do you connect your identity to the space in some way?". This is especially relevant in light of recent evidence that from the 5W2W framework, activities relating to

learning and taking noticing of your surroundings were the strongest predictors for wellbeing, at least in a Global North context (Mackay et al., 2019). Thus potential focus on creating spaces which enable activities that relate to the CES categories of cultural diversity, knowledge systems, educational values, sense of place and identity, inspiration and cultural heritage values could provide a more holistic assessment of wellbeing.

Combining social and physical activities have been suggested to mediate the connection between urban greenspace and mental health benefits in a number of contexts (e.g. Qin et al., 2021 in China; Bagnall et al., 2018 in Global North context). In our study, built spaces were typically associated with social relations, belonging to a particular group and sense of identity linked to that space. These findings demonstrate the flexibility of benefits associated with natural spaces and the variety of opportunities to improve wellbeing they bring compared to the relatively discrete functions of the built spaces we surveyed. To fully explore combined CES wellbeing frameworks, further research is needed to expand upon our approach to better capture aspects of learning and giving that also offer benefits and provide greater clarity on the differential importance of built and natural spaces. This would address the methods shortfall identified by Kosanic and Petzold (2020).

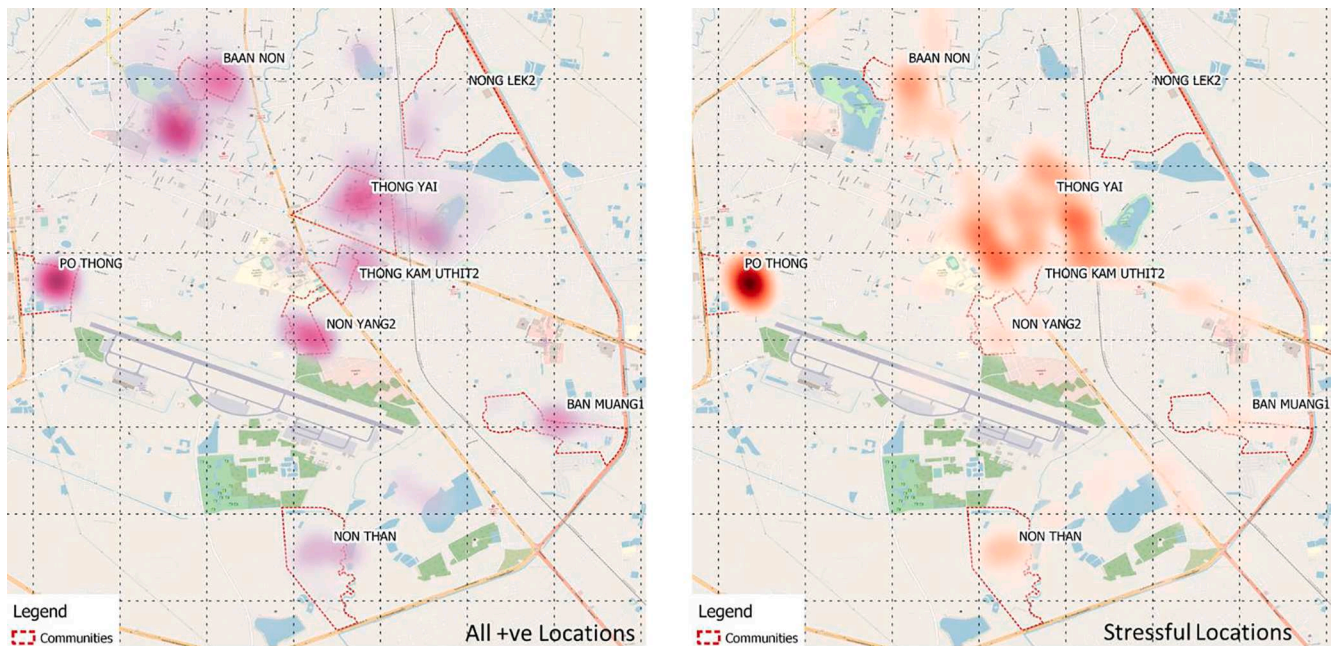


Fig. 7. Hot spot maps for Udon Thani showing concentrations of stressful and positive - relaxing, socialising and exercise - (+ve) locations.

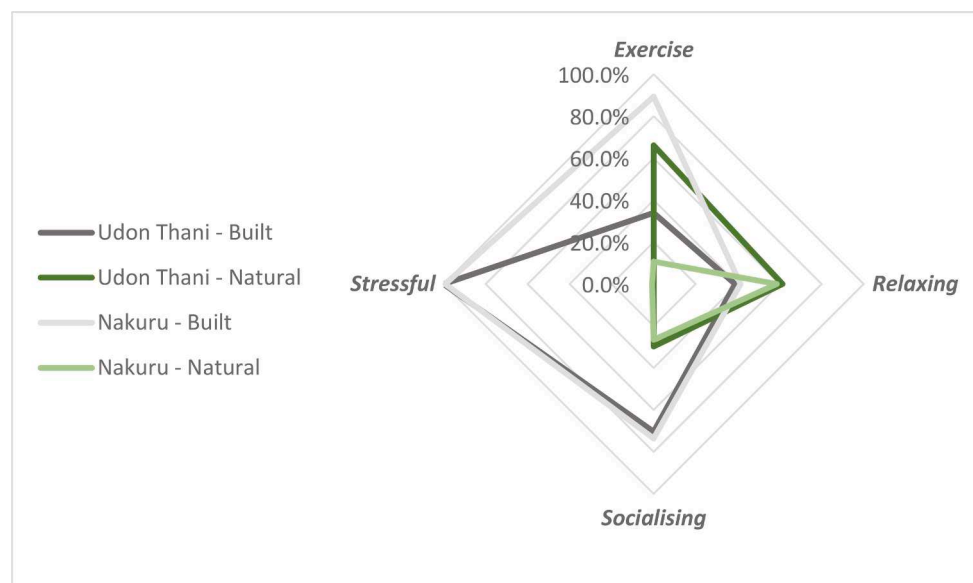


Fig. 8. Comparison of Udon Thani and Nakuru responses and the categories of spaces which they described as either stressful or favourite places to exercise, relax, and socialise.

#### Factors moderating access to wellbeing benefits

Our study suggests the importance of contextual factors in influencing whether people can take advantage of the PRS and their potential CES-wellbeing benefits. These include the natural characteristics of the space, including accessibility, infrastructure and management (see Mao et al., 2020 for a review). In our study, UGS infrastructure played a role in space preferences, for example to provide shade and cooling. Insufficient management of environments (cleanliness) or its actors (anti-social behaviour or traffic) caused places to be experienced as stressful and thus limited the ability of the space to support wellbeing. In the case of accessibility, our findings indicate that accessibility is more than the distance to the urban green space from home (Cox et al., 2017). Our data reveals that preferred location for some activities was also influenced by

proximity to other daily activities (work) and routes (commuting). In line with recent studies (Quatrini et al., 2019; Bullock et al., 2018), our findings also highlight the importance of extending traditional accessibility indicators to include the usability of spaces, the availability of infrastructure, and affordability (costs). This more nuanced conceptualisation is also supported by Bagnall et al. (2018), a systematic review of Global North related literature on wellbeing and space, which recognises accessibility to include ability, attitude, culture, finance, transport and location.

Our spatial analysis highlighted significant differences in the relative greenness of places linked to activities. In Nakuru, the semi-informal settlements have the lowest amounts of greenery and lack of public spaces, indicating differences in provision between neighbourhoods. However, it should be kept in mind that greenness does not provide a



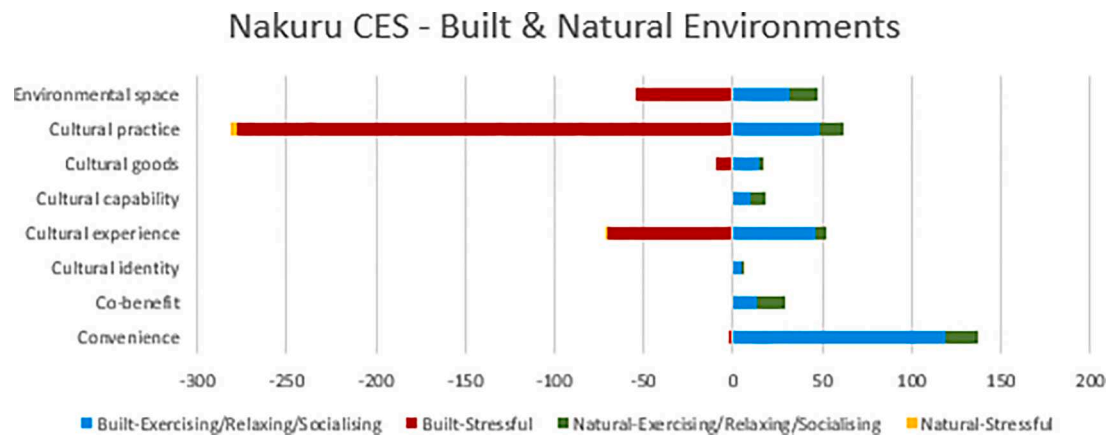


Fig. 9. Coded responses of cultural ecosystem service by type of place (built-natural) and positive or negative (stressful) service for Nakuru. Note the summed scores for the positive services of exercise, relaxing and socialising have been divided by three to balance with the single negative stressful category.

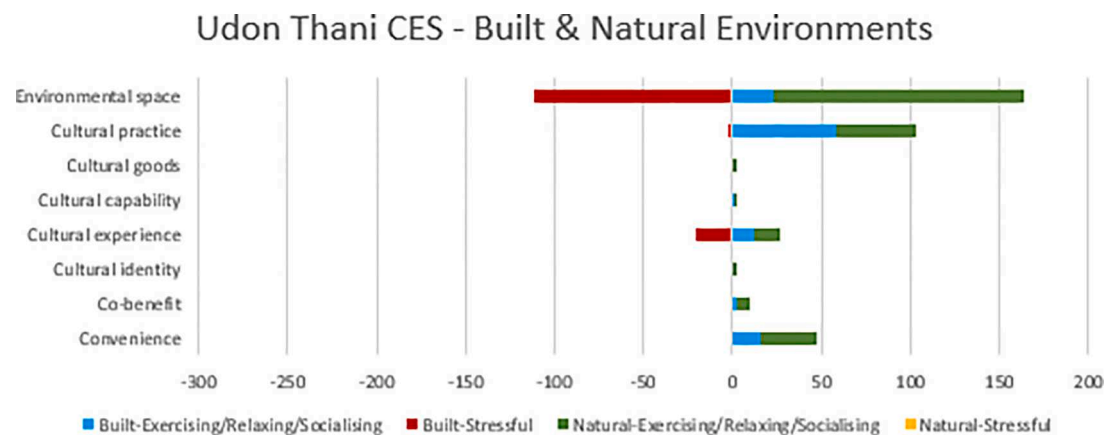


Fig. 10. Coded responses of cultural ecosystem service by type of place (built-natural) and positive or negative (stressful) service for Udon Thani. Note the summed scores for the positive services of exercise, relaxing and socialising have been divided by three to balance with the single negative stressful category.

measurement of accessibility. In Nakuru, green spaces that do exist are often not publicly accessible. Instead, they are private (e.g. golf courses or sports club) or have alternative land uses (such as agriculture) which prevents their use by the majority of the city residents. In Udon Thani, whilst similar issues may occur, the sub-tropical climate ensures vegetation, including street trees, are more naturally widely dispersed across neighbourhoods increasing the accessibility of nature (except in the heavily commercial central districts). The need for dispersion of green infrastructure to support equitable wellbeing is supported by findings by Cinderby et al. (2021).

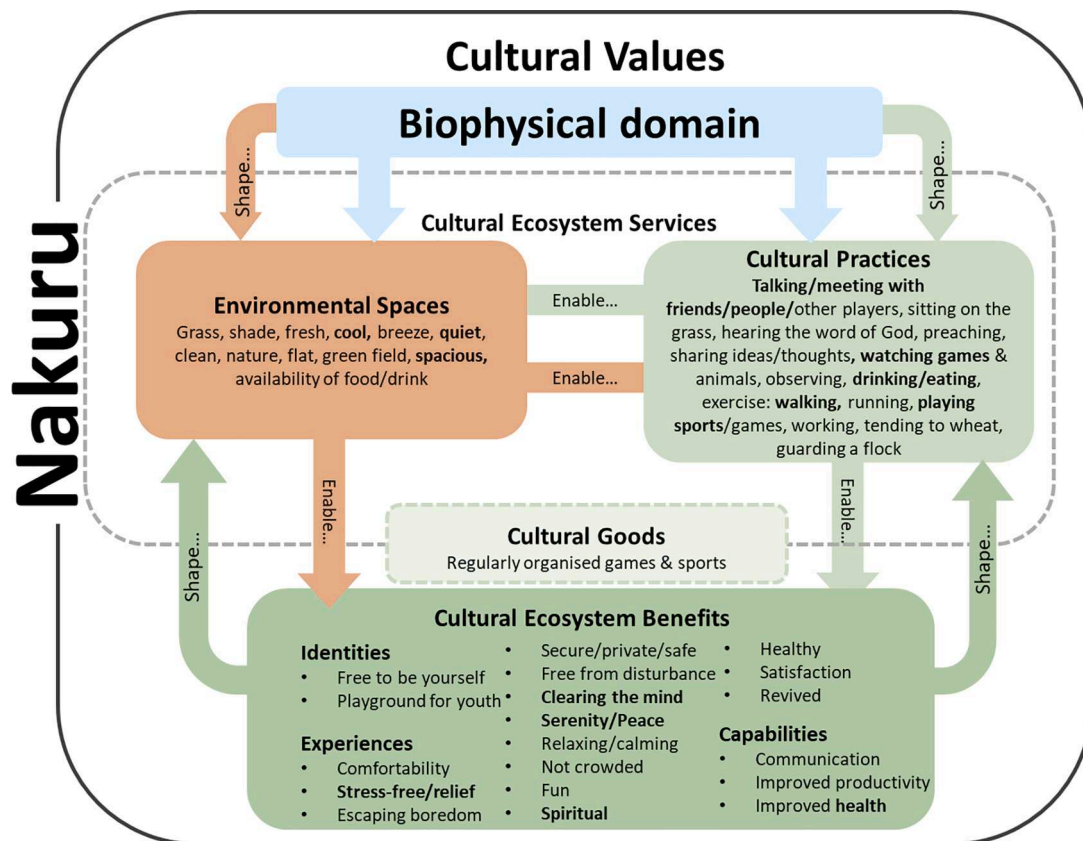
Where available, natural spaces in Nakuru were used for relaxing, socialising and exercise. However, the two largest public parks are located in the city-centre and their highly managed form, including cultural norms, regulation of behaviour by police, and the absence of supporting infrastructure, may preclude their more active use for exercise. In Udon Thani, the higher availability of accessible green space influenced use preferences for relaxation and exercise, especially for younger people.

#### Recommendations for urban development

Our study supports taking a broader perspective on public realm spaces when considering wellbeing benefits. Making existing urban spaces greener, but also more convenient and accessible, can promote societal wellbeing. Recognition is also needed about how form and management (of the space and its actors) affects use, either regulating or enabling use. The differing requirements for desired cultural practices,

e.g. physical exercise versus spiritual practices, should be considered when planning specific benefits. A deeper look into the use of spaces could inform prioritisation for integrating more greenery into built areas, particularly in informal settlement upgrading and urban regeneration programmes or as a part of infrastructure investments in LMIC. This could include planning significant new greenspaces or integrated blue-green corridors so that people have alternative pathways which avoid exposure to heat, air pollution, and traffic-related risks, or adding greenery to frequently used built spaces to enable further benefits from these existing spaces.

Our findings highlight that very different ecosystems (tropical-savanna (Udon) to warm-Mediterranean (Nakuru)) can provide similar CES and benefits. The question then is what level of green – or brown in dry locations or seasons – enables these benefits. Should planners prioritise the greening of dispersed accessible low-resource and -maintenance intensity natural spaces and marginal public realm spaces over high-upkeep green public spaces? Our results indicate that increasing public accessibility in key higher maintenance locations (e.g. parks) should be balanced with the greening of frequently accessed locations to ensure spatial justice and equitable benefits across populations. Dispersed lower-quality natural spaces may provide greater equity of wellbeing and cultural service benefits across urban populations than concentrating resources on fewer, larger, highly maintained locations. Wider distribution is also supported by the finding that people are relaxing, socialising and exercising in proximity to a variety of places – close to their home, during daily activities and on the routes connecting them. For example, in Nakuru, current brown spaces, such as road



**Fig. 11.** Reasons respondents in Nakuru gave for selecting their favourite natural spaces for exercising, socialising and relaxing placed in the CES Framework by Fish et al. (2016). Bolded words are terms that respondents also used to describe favourite built spaces.

verges, which are often informal and less maintained, are regularly used. A focus on more equitable distribution of green space that enables recreation could, however, entail trade-offs with other ecosystem services which greenspaces provide (Raudsepp-Hearne et al. 2010).

While the ecosystem services concept was developed specifically in relation to natural environments, it can be useful to apply to public spaces with various grades of “ecosystem”. While our study used a binary coding (built or natural), many of the favourite built spaces identified, e.g. places of worship in Udon Thani, include a mix of man-made and natural, or more specifically, a mix of blue-, green-, brown-, and grey- space. A recognition of a wider range of recognised spatial elements considered to provide CES related benefits (Roy et al., 2018), especially ones typical for urban settings in the Global South, could also open up options for more ways to improve and maintain the level of benefits. Mao et al. (2020) also recommend further research on residential areas for their mix of elements, but similarly, streetscapes, markets, restaurants, or shopping areas represent a mix of buildings, paving and greenery. As locations with lower levels of greenery have the potential to enable activities such as socialising and exercising, further research could explore how the extent of greenery influences use and preference for spaces and the resulting mental wellbeing benefits. Earlier studies show that higher levels of green space in deprived urban communities are linked with lower perceived stress (Ward Thompson et al. 2012; Roe et al., 2013). Could the stress of built public spaces or anti-social behaviour be mitigated by increasing greenery?

## Conclusion

This paper contributes to the limited evidence of urban CES in the Global South context and presents the findings from a study set up in two LMIC secondary cities using a PGIS on-street survey. The interlinkages between urban public spaces, CES, and residents’ wellbeing explored in

this study facilitated the opportunity to go deeper into understanding the role of public spaces in cities in the Global South. In other words, it enabled us to explore not only *what* public spaces people use for different activities, but also *how* and *why* certain public spaces are preferred, and how it connects to citizens’ wellbeing. Our results show that very different ecosystems produced similar CES-related wellbeing benefits, and that both natural and built areas are important spaces for socialising, relaxing and exercising. The residents in Nakuru, Kenya and Udon Thani, Thailand mostly preferred the same types of locations for socialising, relaxing and exercising, although some differences were also found. The study showed that public spaces offered ample opportunity to create important cultural experiences, as well as some cultural capabilities and identities. The results also identified that convenience (proximity and affordability), and usability influenced the accessibility of spaces. By connecting our findings with the 5W2W framework, the study enabled us to open up a way to overcoming the existing deficit in understanding the connection cultural ecosystem services have to causal pathways to mental health improvements in cities in the Global South.

These findings show the importance of urban natural and built public realm spaces for residents’ wellbeing, highlighting the effects of the inequitable distribution of inviting public realm spaces across the cities, and consider the impacts on spatial justice. This type of investigation has the potential to support more robust and inclusive city planning, as well as strengthen the argument for protecting public spaces by showing its connection to important cultural ecosystem services and citizens wellbeing. Finally, this study highlights the need to fully recognise the range of public realm spaces that provide value to residents and to include wellbeing in the urban planning of rapidly changing cities.

## Declaration of interests

The authors declare that they have no known competing financial

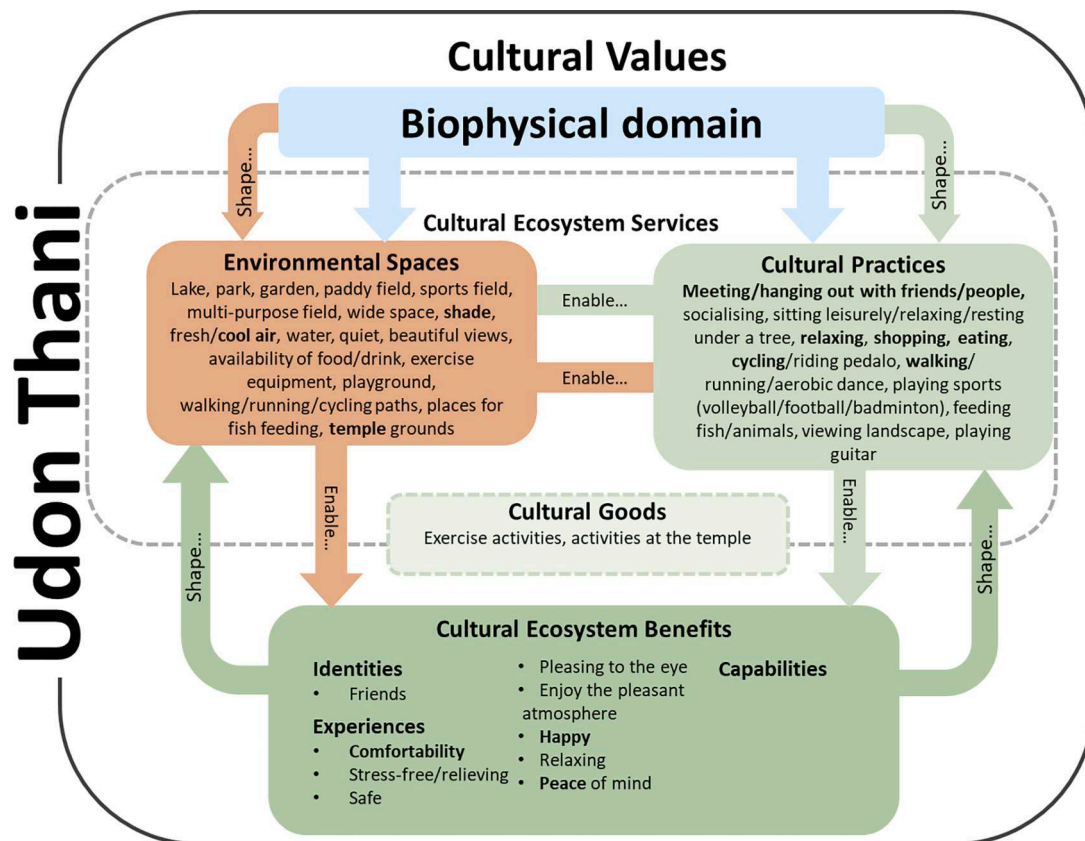


Fig. 12. Reasons respondents in Udon Thani gave for selecting their favourite natural spaces for exercising, socialising and relaxing placed in the CES Framework by Fish et al. (2016). Bolded words are terms that respondents also used to describe favourite built spaces.

interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.wss.2021.100071.

## References

Adlakha, D., Chandra, M., Krishna, M., Smith, L., Tully, M.A., 2021. Designing age-friendly communities: exploring qualitative perspectives on urban green spaces and ageing in two indian megacities. *Int. J. Environ. Res. Public Health* 18 (4), 1491. <https://doi.org/10.3390/ijerph18041491>.

Aked, J., Marks, N., Cordon, C., Thompson, S., 2008. *Five ways to wellbeing: a report presented to the foresight project on communicating the evidence base for improving people's well-being*. New Econ. Found.

Bagnall, A.-M., South, J., Di Martino, S., Southby, K., Pilkington, G., Mitchell, B., Pennington, A., Corcoran, R., 2018. *Places, Spaces, People and Wellbeing: full Review, A Systematic Review of Interventions to Boost Social Relations through Improvements in Community Infrastructure*. Places and Spaces.

Bullock, C., Joyce, D., Collier, M., 2018. An exploration of the relationships between cultural ecosystem services, socio-cultural values and well-being. *Ecosyst. Serv.* 31, 142–152. <https://doi.org/10.1016/j.ecoser.2018.02.020>.

Burls, A., 2007. People and green spaces: promoting public health and mental well-being through ecotherapy. *J. Public Ment. Health* 6 (3), 24–39. <https://doi.org/10.1108/17465729200700018>.

Cattell, V., Dines, N., Gesler, W., Curtis, S., 2008. Mingling, observing, and lingering: everyday public spaces and their implications for well-being and social relations. *Health Place* 14 (3), 544–561. <https://doi.org/10.1016/j.healthplace.2007.10.007>.

Chan, K.M.A., Satterfield, T., Goldstein, J., 2012. Rethinking ecosystem services to better address and navigate cultural values. *Ecol. Econ.* 74, 8–18. <https://doi.org/10.1016/j.ecolecon.2011.11.011>.

Cinderby, S., 2010. How to reach the 'hard-to-reach': the development of Participatory Geographic Information Systems (P-GIS) for inclusive urban design in UK cities. *Area* 42 (2), 239–251. <https://doi.org/10.1111/j.1475-4762.2009.00912.x>.

Cinderby, S., Archer, D., Mehta, V.K., Neale, C., Opiyo, R., Pateman, R.M., Muhoza, C., Adelina, C., Tuhkanen, H., 2021. Assessing inequalities in wellbeing at a neighbourhood scale in low-middle-income-country secondary cities and their implications for long-term livability. *Front. Sociol.* 6, 729453. <https://doi.org/10.3389/fsoc.2021.729453>.

Cinderby, S., Bagwell, S., 2018. Exploring the co-benefits of urban green infrastructure improvements for businesses and workers' wellbeing. *Area* 50 (1), 126–135. <https://doi.org/10.1111/area.12361>.

Cohen, B., 2006. Urbanization in developing countries: current trends, future projections, and key challenges for sustainability. *Technol. Soc.* 28, 63–80. <https://doi.org/10.1016/j.techsoc.2005.10.005>.

Cox, D., Shanahan, D., Hudson, H., Fuller, R., Anderson, K., Hancock, S., Gaston, K., 2017. Doses of nearby nature simultaneously associated with multiple health benefits. *Int. J. Environ. Res. Public Health* 14 (2), 172. <https://doi.org/10.3390/ijerph14020172>.

D'Acci, L., 2011. Measuring well-being and progress. *Soc. Indic. Res.* 104 (1), 47–65. <https://doi.org/10.1007/s11205-010-9717-1>.

Dickinson, D.C., Hobbs, R.J., 2017. Cultural ecosystem services: characteristics, challenges and lessons for urban green space research. *Ecosyst. Serv.* 25, 179–194. <https://doi.org/10.1016/j.ecoser.2017.04.014>.



- EEA, 2015. FRESH Thinking for a New Era in Environmental Health and Well-Being.
- Faehnle, M., Bäcklund, P., Tyrväinen, L., Niemelä, J., Yli-Pelkonen, V., 2014. How can residents' experiences inform planning of urban green infrastructure? Case Finland. *Landsc Urban Plan* 130, 171–183. <https://doi.org/10.1016/j.landurbplan.2014.07.012>.
- Fischer, L.K., Honold, J., Botzat, A., Brinkmeyer, D., Cvejic, R., et al., 2018. Recreational ecosystem services in European cities: sociocultural and geographical contexts matter for park use. *Ecosyst. Serv.* 31, 455–467. <https://doi.org/10.1016/j.ecoser.2018.01.015>.
- Fish, R., Church, A., Winter, M., 2016. Conceptualising cultural ecosystem services: a novel framework for research and critical engagement. *Ecosyst. Serv.* 21, 208–217. <https://doi.org/10.1016/j.ecoser.2016.09.002>.
- GIZ, 2021. *Summary of baseline assessments for nakuru county: risk and Vulnerability Assessment. Baseline Emission Inventory and Assess to Energy Assessment.*
- Guenat, S., Dougill, A.J., Kunin, W.E., Dallimer, M., 2019. Untangling the motivations of different stakeholders for urban greenspace conservation in sub-Saharan Africa. *Ecosyst. Serv.* 36 (August 2018), 100904 <https://doi.org/10.1016/j.ecoser.2019.100904>.
- Gwedla, N., Shackleton, C.M., 2015. The development visions and attitudes towards urban forestry of officials responsible for greening in South African towns. *Land Use Policy* 42, 17–26. <https://doi.org/10.1016/j.landusepol.2014.07.004>.
- Haase, D., Larondelle, N., Andersson, E., Artmann, M., Borgström, S., et al., 2014. A quantitative review of urban ecosystem service assessments: concepts, models, and implementation. *Ambio* 43 (4), 413–433. <https://doi.org/10.1007/s13280-014-0504-0>.
- Haver, A., Akerjordet, K., Caputi, P., Furunes, T., Magee, C., 2015. Measuring mental well-being: a validation of the Short Warwick-Edinburgh Mental Well-Being Scale in Norwegian and Swedish. *Scand. J. Public Health* 43 (7), 721–727. <https://doi.org/10.1177/1403494815588862>.
- ISCT, TEI and NISTPASS, 2014. Mekong- Building Climate Resilience in Asian Cities (M-BRACE). <https://www.i-s-e-t.org/publications-and-resources-1/city-brief-udon-thani%2C-thailand>.
- Juntti, M., Costa, H., Nascimento, N., 2021. Urban environmental quality and wellbeing in the context of incomplete urbanisation in Brazil: integrating directly experienced ecosystem services into planning. *Prog. Plann.* 143, 100433 <https://doi.org/10.1016/j.progress.2019.04.003>.
- Kabisch, N., Haase, D., 2014. Green justice or just green? Provision of urban green spaces in Berlin, Germany. *Landsc Urban Plan.* 122, 129–139. <https://doi.org/10.1016/j.landurbplan.2013.11.016>.
- Kosanic, A., Petzold, J., 2020. A systematic review of cultural ecosystem services and human wellbeing. *Ecosyst. Serv.* 45 (June), 101168 <https://doi.org/10.1016/j.ecoser.2020.101168>.
- Kotsila, P., Anguelovski, I., Baró, F., Langemeyer, J., Sekulova, F., Connolly, J.J.T., 2020. Nature-based solutions as discursive tools and contested practices in urban nature's neoliberalisation processes. *Environ. Plann. E.* <https://doi.org/10.1177/2514848620901437>, 2514848620901437.
- Lopez, B., Kennedy, C., McPhearson, T., 2020. Parks are critical urban infrastructure: perception and use of urban green spaces in NYC during COVID-19. *Soc. Sci.* <https://doi.org/10.20944/preprints202008.0620.v1>.
- Mackay, L., Egli, V., Booker, L.-J., Prendergast, K., 2019. New Zealand's engagement with the five ways to wellbeing: evidence from a large cross-sectional survey. *Kōtuitui* 14 (2), 230–244. <https://doi.org/10.1080/1177083X.2019.1603165>.
- Mäkinen, K., Tyrväinen, L., 2008. Teenage experiences of public green spaces in suburban Helsinki. *Urban Forest. Urban Green.* 7 (4), 277–289. <https://doi.org/10.1016/j.ufug.2008.07.003>.
- Mao, Q., Wang, L., Guo, Q., Li, Y., Liu, M., Xu, G., 2020. Evaluating cultural ecosystem services of urban residential green spaces from the perspective of residents' satisfaction with green space. *Front. Public Health* 8, 226. <https://doi.org/10.3389/fpubh.2020.00226>.
- Mehta, V., 2014. Evaluating public space. *J. Urban Des.* 19 (1), 53–88. <https://doi.org/10.1080/13574809.2013.854698>.
- Millennium Ecosystem Assessment, 2005. *Ecosystems and Human Well-Being: Synthesis.* Island Press, Washington DC.
- Muhamad Nor, A.N., Abdul Aziz, H., Nawawi, S.A., Muhammad Jamil, R., Abas, M.A., et al., 2021. Evolution of green space under rapid urban expansion in Southeast Asian cities. *Sustainability* 13 (21), 12024. <https://doi.org/10.3390/su132112024>.
- Mundoli, S., Manjunatha, B., Nagendra, H., 2017. Commons that provide: the importance of Bengaluru's wooded groves for urban resilience. *Int. J. Urban Sustain. Dev.* 9 (2), 184–206. <https://doi.org/10.1080/19463138.2016.1264404>.
- Nawrath, M., Guenat, S., Else, H., Dallimer, M., 2021. Exploring uncharted territory: do urban greenspaces support mental health in low- and middle-income countries? *Environ. Res.* 194 (August 2020) <https://doi.org/10.1016/j.envres.2020.110625>.
- Neuvonen, M., Sievänen, T., Tönnies, S., Koskela, T., 2007. Access to green areas and the frequency of visits – a case study in Helsinki. *Urban Forest. Urban Green.* 6 (4), 235–247. <https://doi.org/10.1016/j.ufug.2007.05.003>.
- Norton, L.R., Inwood, H., Crowe, A., Baker, A., 2012. Trialling a method to quantify the 'cultural services' of the English landscape using Countryside Survey data. *Land Use Policy* 29 (2), 449–455. <https://doi.org/10.1016/j.landusepol.2011.09.002>.
- Özgüner, H., 2011. Cultural differences in attitudes towards urban parks and green spaces. *Landsc. Res.* 36 (5), 599–620. <https://doi.org/10.1080/01426397.2011.560474>.
- Paul, S., Nagendra, H., 2017. Factors influencing perceptions and use of urban nature: surveys of park visitors in Delhi. *Land* 6 (2), 27. <https://doi.org/10.3390/land6020027>.
- Pearce, J., Cherrie, M., Shortt, N., Deary, I., Ward Thompson, C., 2018. Life course of place: a longitudinal study of mental health and place. *Trans. Inst. Br. Geogr.* 43 (4), 555–572. <https://doi.org/10.1111/tran.12246>.
- Pröbstl-Haider, U., 2015. Cultural ecosystem services and their effects on human health and well-being – a cross-disciplinary methodological review. *J. Outdoor Recreat. Tour.* 10, 1–13. <https://doi.org/10.1016/j.jort.2015.07.004>.
- Qin, B., Zhu, W., Wang, J., Peng, Y., 2021. Understanding the relationship between neighbourhood green space and mental wellbeing: a case study of Beijing, China. *Cities* 109, 103039. <https://doi.org/10.1016/j.cities.2020.103039>.
- Quatrin, V., Tomao, A., Corona, P., Ferrar, B., Masini, E., Agrimi, M., 2019. Is new always better than old? Accessibility and usability of the urban green areas of the municipality of Rome. *Urban Forest. Urban Green.* 37, 126–134. <https://doi.org/10.1016/j.ufug.2018.07.015>.
- Raudsepp-Hearne, C., Peterson, G.D., Bennett, E.M., 2010. Ecosystem service bundles for analyzing tradeoffs in diverse landscapes. *Proc. Natl. Acad. Sci.* 107 (11), 5242–5247. <https://doi.org/10.1073/pnas.0907284107>.
- Riechers, M., Barkmann, J., Tschamtk, T., 2018. Diverging perceptions by social groups on cultural ecosystem services provided by urban green. *Landsc. Urban Plan.* 175, 161–168. <https://doi.org/10.1016/j.landurbplan.2018.03.017>.
- Riechers, M., Noack, E.M., Tschamtk, T., 2017. Experts' versus laypersons' perception of urban cultural ecosystem services. *Urban Ecosyst.* 20 (3), 715–727. <https://doi.org/10.1007/s11252-016-0616-3>.
- Riechers, M., Strack, M., Barkmann, J., Tschamtk, T., 2019. Cultural ecosystem services provided by urban green change along an urban-periurban gradient. *Sustainability* 11 (3), 645. <https://doi.org/10.3390/su11030645>.
- Roe, J., Thompson, C., Aspinall, P., Brewer, M., Duff, E., Miller, D., Mitchell, R., Clow, A., 2013. Green space and stress: evidence from cortisol measures in deprived urban communities. *Int. J. Environ. Res. Public Health* 10 (9), 4086–4103. <https://doi.org/10.3390/ijerph10094086>.
- Roy, M., Shemdoe, R., Hulme, D., Mwageni, N., Gough, A., 2018. Climate change and declining levels of green structures: life in informal settlements of Dar es Salaam, Tanzania. *Landsc. Urban Plan.* 180, 282–293. <https://doi.org/10.1016/j.landurbplan.2017.11.011>.
- Ryan, R.M., Deci, E.L., 2001. On happiness and human potentials: a review of research on hedonic and eudaimonic well-being. *Annu. Rev. Psychol.* 52 (1), 141–166. <https://doi.org/10.1146/annurev.psych.52.1.141>.
- Sahakian, M., Anantharaman, M., Di Giulio, A., Saloma, C., Zhang, D., et al., 2020. Green public spaces in the cities of South and Southeast Asia. Protecting needs towards sustainable well-being. *J. Public Space* 5 n (2), 89–110. <https://doi.org/10.32891/jps.v5i2.1286>.
- Shepley, M., Sachs, N., Sadatsafavi, H., Fournier, C., Peditto, K., 2019. The impact of green space on violent crime in urban environments: an evidence synthesis. *Int. J. Environ. Res. Public Health* 16 (24), 5119. <https://doi.org/10.3390/ijerph16245119>.
- Shuvo, F.K., Feng, X., Akaraci, S., Astell-Burt, T., 2020. Urban green space and health in low and middle-income countries: a critical review. *Urban Forest. Urban Green.* 52, 126662. <https://doi.org/10.1016/j.ufug.2020.126662>.
- Tarbut, M., 2021. *Inequalities in Accessing the Benefits of Urban Greenspaces in Middle-Income Countries: Evidence from Two Case Study Cities.* University of York.
- Taylor, L., Hochuli, D.F., 2017. Defining greenspace: multiple uses across multiple disciplines. *Landsc. Urban Plan.* 158, 25–38. <https://doi.org/10.1016/j.landurbplan.2016.09.024>.
- Tyrväinen, L., Ojala, A., Korpela, K., Lanki, T., Tsunetsugu, Y., Kagawa, T., 2014. The influence of urban green environments on stress relief measures: a field experiment. *J. Environ. Psychol.* 38, 1–9. <https://doi.org/10.1016/j.jenvp.2013.12.005>.
- United Nations, 2017. New Urban Agenda. UN Habitat III Secretariat. <https://habitat3.org/wp-content/uploads/NUA-English.pdf>.
- United Nations, 2020. Global Indicator Framework for the Sustainable Development Goals and Targets of the 2030 Agenda for Sustainable Development. UN Resolution A. RES/71/313. [https://unstats.un.org/sdgs/indicators/Global%20Indicator%20Framework%20after%202021%20refinement\\_Eng.pdf](https://unstats.un.org/sdgs/indicators/Global%20Indicator%20Framework%20after%202021%20refinement_Eng.pdf).
- van Melik, R., Pijpers, R., 2017. Older people's self-selected spaces of encounter in urban aging environments in the Netherlands. *City Commun.* 16 (3), 284–303. <https://doi.org/10.1111/cico.12246>.
- Wangai, P.W., Burkhard, B., Müller, F., 2016. A review of studies on ecosystem services in Africa. *Int. J. Sustain. Built Environ.* 5 (2), 225–245. <https://doi.org/10.1016/j.ijsbe.2016.08.005>.
- Ward Thompson, C., Roe, J., Aspinall, P., Mitchell, R., Clow, A., Miller, D., 2012. More green space is linked to less stress in deprived communities: evidence from salivary cortisol patterns. *Landsc Urban Plan.* 105 (3), 221–229. <https://doi.org/10.1016/j.landurbplan.2011.12.015>.
- Western, M., Tomaszewski, W., 2016. Subjective wellbeing, objective wellbeing and inequality in Australia. *PLoS One* 11 (10), 1–20. <https://doi.org/10.1371/journal.pone.0163345>.