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Neighborhood Sustainability Assessment (NSA) Tools: A systematic review on how to choose the best analysis tool

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INTRODUCTION

- World population growth ———————▶ Urban population increase

- Sustainability in cities?

- Neighborhood Sustainability Assessment (NSA)

- List of categories and indicators with a framework for analyzing the neighborhood.
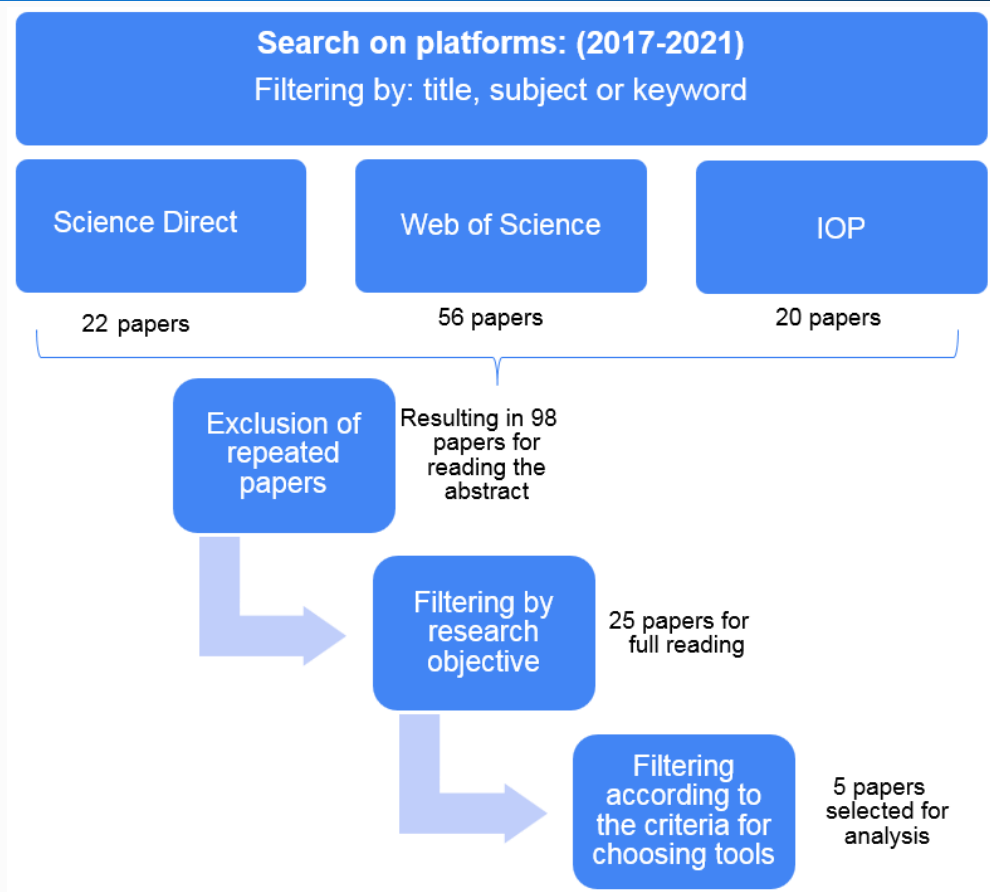
OBJECTIVES OF THE PAPER

The objective of this work is to analyze the state of the art of non-commercial NSA tools, looking for similarities between the chosen tools and to compare the theoretical basis with the literature on sustainability in neighborhoods.
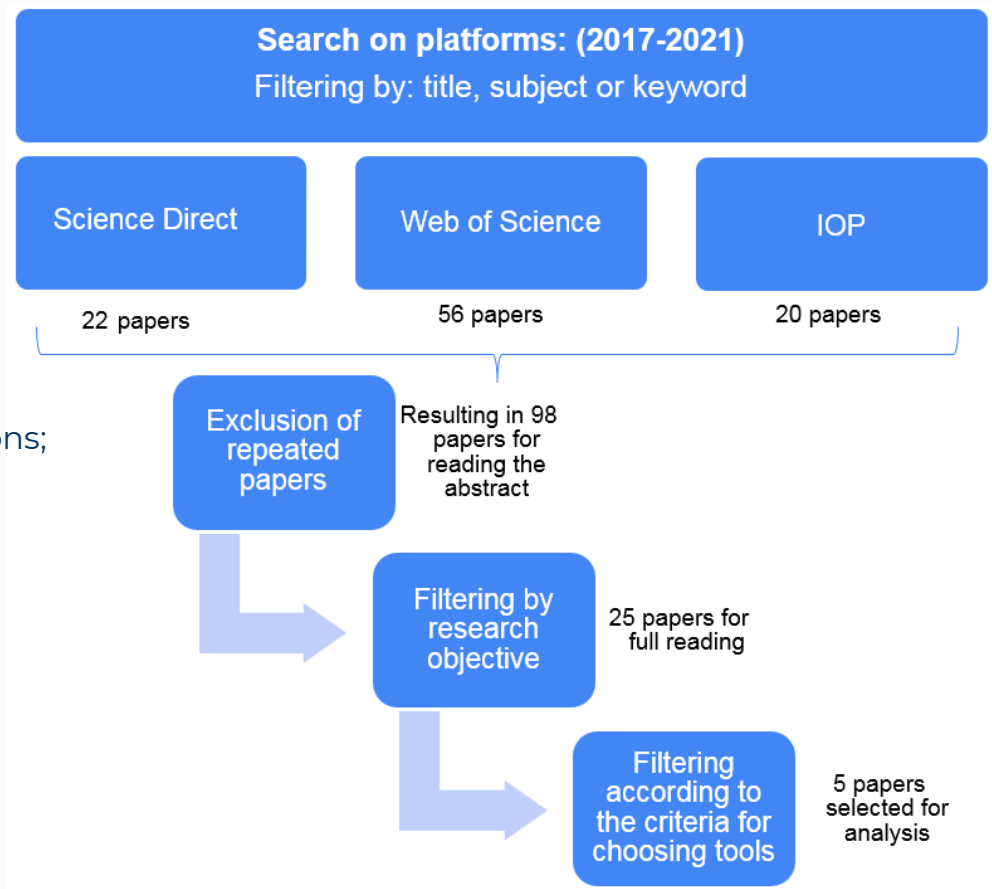
APPROACH USED

- Systematic Literature Review (SLR)

Search terms (2017-2021)
"Neighborhood sustainability assessment"
Neighborhood sustainability assessment
"Neighborhood sustainability assessment" AND "tool"
Neighborhood sustainability assessment AND tool
"Neighborhood sustainability assessment" AND "indicators"
Neighborhood sustainability assessment AND indicators

Search on platforms: (2017-2021)
Filtering by: title, subject or keyword

Science Direct	Web of Science	IOP
22 papers	56 papers	20 papers

Exclusion of repeated papers

Resulting in 98 papers for reading the abstract

Filtering by research objective

25 papers for full reading

Filtering according to the criteria for choosing tools

5 papers selected for analysis

APPROACH USED

- 5 selected tools

- 4 steps for tool analysis:

a) Identification of the publications informations;

b) Interpretation of tools;

c) Similarity analysis

d) Discussion

Search on platforms: (2017-2021)
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Resulting in 98 papers for reading the abstract

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Filtering according to the criteria for choosing tools

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RESULTS

a) Identification of the publications informations

TABLE 01 - Selected NSA tools

Authors	Year	Paper	Journal/Conference
Subramanian et al	(2020)	Advancing neighbourhood sustainability assessment by accounting for sustainable development goals: A case study of Sha Tin neighbourhood in Hong Kong	Sustainable Cities and Society
Balaras et al	(2020)	A transnational multicriteria assessment method and tool for sustainability rating of the built environment	SBE19 Thessaloniki "Sustainability in the built environment for climate change mitigation"
Buzási; Jäger,	(2020)	District-scale assessment of urban sustainability	Sustainable Cities and Society
Moroke; Schoeman, & Schoeman	(2019)	Developing a neighbourhood sustainability assessment model: An approach to sustainable urban development	Sustainable Cities and Society
Zheng et al.	(2017)	Neighborhood sustainability in urban renewal: An assessment framework	Environment and Planning B: Planning and Design

RESULTS

b) Interpretation of tools;

TABLE 02 - Framework of the NSA tools

Authors	Subramanian et al (2020)	Balaras et al (2020)	Buzási; Jäger, (2020)	Moroke; Schoeman, & Schoeman (2019)	Zheng et al. (2017)
Theoretical basis	Geospatial NSA tool based on SDG and Five Capitals Model	EU transnational project guidelines and public assessment systems	Literature	Literature	Literature and expert review
Categories and indicators	5 categories and 26 indicators	Building ladder: 7 categories and 153 indicators; Neighborhood scale 7 categories and 178 indicators;	3 categories and 30 indicators	10 categories and 31 sub-indicators	5 categories and 27 indicators
Selection of indicators	list of indicators	list of pre-selected indicators	list of indicators	list of indicators	list of indicators
Data source	census data, monitoring data, and spatial data are the three main data types needed	government data, technical documents, census and monitoring data	government data, technical documents	Literature	spatial data and government sources
Calculation methods	mathematical calculations and normalization from 0 to 1	Indicator data is normalized from -1 to +5	data are collected and organized by the Guilford weighting method to classify the results	Mathematical calculations and statistical inferences, resulting in a rating from 1 to 5	mathematical calculations and normalization
Results method	GIS, heat map	sustainability performance framework	graphic mapping	sustainability performance framework	Decision making matrix

RESULTS

c) Similarity analysis

- grouping the indicators by similar themes

TABLE 03 - Grouping by indicator themes

Indicator theme	Subramanian et al (2020)	Balaras et al (2020)	Buzási; Jäger, (2020)	Moroke; Schoeman & Schoeman (2019)	Zheng et al. (2017)
Public transportation	Proximity to public transportation stops/stations	Impact of local building user population on peak load capacity of public transport system	Public transport supply	Public transport usage	diversity of public transport

RESULTS

c) Similarity analysis

TABLE 04 - Similarity of indicators (Environmental)

Category	Indicator Themes	Subramanian et al (2020)	Balaras et al (2020)	Buzási; Jäger, (2020)	Moroke; Schoeman & Schoeman (2019)	Zheng et al. (2017)
Environmental	Air quality	x	x	x	-	x
Environmental	Recycling points	x	x	x	-	x
Environmental	Water quality	x	x	-	-	-
Environmental	Availability of green area	x	x	x	x	x
Environmental	Noise pollution	x	x	x	-	-
Environmental	Surface water quality	x	x	-	-	-
Environmental	Proportion of bike path and streets	-	x	x	-	-

x: indicator is included in the tool;
-: not included in the tool.

RESULTS

c) Similarity analysis

TABLE 04 - Similarity of indicators (Economic)

Category	Indicator Themes	Subramanian et al (2020)	Balaras et al (2020)	Buzási; Jäger, (2020)	Moroke; Schoeman & Schoeman (2019)	Zheng et al. (2017)
Economic	Diversification of professionals	x	-	-	x	x
Economic	Proximity to financial services	x	-	-	x	-
Economic	Availability of licensed food services	x	x	-	x	-
Economic	Public transportation	x	x	x	x	x
Economic	Population income	x	x	x	-	x
Economic	Cost of living	x		-	x	-
Economic	Unemployment rate	x	x	x	-	-
Economic	Diversity of business activities	-	-	x	x	x
Economic	Local market	-	x	-	-	x
Economic	Building maintenance	-	x	-	-	x
Economic	Access to home ownership	x	x	-	x	x

x: indicator is included in the tool;
-: not included in the tool.

RESULTS

c) Similarity analysis

TABLE 04 - Similarity of indicators (Social)

Category	Indicator Themes	Subramanian et al (2020)	Balaras et al (2020)	Buzási; Jäger, (2020)	Moroke; Schoeman & Schoeman (2019)	Zheng et al. (2017)
Social	Access to educational services	x	x	x	x	x
Social	Access to health services	x		-	x	x
Social	Age diversity	x		x	x	x
Social	Energy consumption	x	x	x	-	x
Social	Immigration	x		x	-	-
Social	Proportion of work of men and women	x	-	x	-	x
Social	Crime	x		x	x	-
Social	Proximity to the government office	x		-	x	x
Social	Population density	x	x	x	x	x
Social	Accessibility in the public environment	-	x	-	x	-
Social	Government and community integration	-	x	-	x	-
Social	Community gardens / urban agriculture	-	x	x	-	-
Social	Access recreational areas	-	x	-	-	x

x: indicator is included in the tool;
-: not included in the tool.

RESULTS

d) Discussion

- All tools use the principles of the sustainability tripod directly or indirectly on the theoretical basis.

- Buzási; Jäger (2020) the relationship with the sustainability tripod is more evident, because the categories have the same name as the legs of the tripod.

- Moroke; Schoeman & Schoeman (2019) and Balaras et al (2020) present the categories in more detail, social, environmental and economic issues are intrinsic to the analysis.

- Subramanian et al (2020) uses the SDG and the Five Capitals Model to categorize the indicators, this approach allows for a direct correlation between results and sustainability goals.

RESULTS

d) Discussion

TABLE 05 - Tools analysis categories

Authors	Categories
Subramanian et al (2020)	Natural capital. Social Capital, Manufactured Capital, Financial Capital, Human Capital.
Balaras et al (2020)	A1 Urban Structure and Form; A2 Transportation Infrastructure; B1 Economic Structure and Value; B2 Economic activity; B3 Cost and Investment; C1 Non-renewable energy; C2 Renewable and Decarbonised energy; C3 Energy recycling and storage; D1 Atmospheric emissions; E1 Potable water, stormwater and greywater; E2 Solid and Liquid Wastes; E3 Resource consumption, retention and maintenance; F1 Environmental impacts; F2 Outdoor environmental quality; F3 Ecosystems and landscapes; G1 Safety and Accessibility; G2 Traffic and Mobility Services; G3 Communication services;G4 Public and private facilities and services; G5 Local Food; G6 Management and community involvement; G7 Society, Culture and Heritage; G8 Perceptual.
Buzási; Jäger, (2020)	Environmental; Economic; Social
Moroke; Schoeman & Schoeman (2019)	Spatial/environment; Urban density: Unequal distribution of urban population; Cultural and social capital; Connectivity and public transport; Economic; Smart growth; Services (i.e. parks/sport fields/education/transport/housing services); Food security; Urban governance; Liveability.
Zheng et al. (2017)	Social aspect; Economy and work; Resources and environment; Land use form; Building condition.

MAIN CONCLUSIONS

-There are currently several NSA tools.

-The 5 selected tools present a series of similarities in the analysis topics.

-What can be explained by the tools sharing the same theoretical basis as the sustainability tripod, SDGs and international literature directly or indirectly.

-It is not possible to choose which is the best tool. However, it is possible to analyze which is the best tool for each location.

-To choose a tool it is necessary:

       -discover the availability of local data;

       -which is the theoretical basis of the tool;

       - possibility of adaptability of the tool;

       -format of the delivered results.

MAIN CONCLUSIONS

-The tools already evaluate most of the sustainability issues. However, studies with the objective of adapting the tools locally are necessary.

-An alternative would be the availability of lists of pre-selected indicators with similar functions, for the user to substitute in case of unavailability of regional data.

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