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Monitoring and enhancing spontaneous sustainability—a framework

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Abstract

The paper presents and addresses the concept of "spontaneous sustainability", the informal and unplanned sustainable development of communities, as the basis and framework to support the notion, drives, and agendas of "formal sustainability". It follows the interdependence between the "spontaneous sustainability" of "distinct" communities and their "cultural" characteristics, including history, spatial continuity, values and behaviors, the associated physical settings, and tangible and intangible products, which enabled them to continue, survive, and develop. The research aims at formulating and validating a "framework" for monitoring and enhancing the "spontaneous sustainability" of "distinct" communities to enable, support and link it, to the broader frameworks of "sustainable development". The proposed "framework" combines "sustainability" dimensions: environmental, economic, and socio-cultural; and the levels of community contexts, and spatial impact. The "framework" is formulated by integrating selected "urban sustainability" approaches, and systems, with later research that developed the key aspects, criteria, and indicators of those systems, together with research addressing "social and cultural sustainability", and assessment aspects, criteria, and indicators. The "framework" is developed and validated through a limited questionnaire, involving local experts and specialists, academics, and practitioners, to point out limitations and potential, and to suggest the relative importance of its components, key aspects, and criteria. The validation supported the research propositions, the formulation, and development of the proposed "spontaneous sustainability framework" and emphasized its flexibility to include other approaches and agendas, and potential for further development and application in distinct local communities.

Keywords: Community culture, Spontaneous sustainability, Sustainability assessment, Culture, Physical settings

Introduction

Culture is the cumulative result of humans' continuous dialogue and interaction with their settings: natural and man-made. The collective cultural environment of the human settings dialogue may arguably be regarded as the true reflection; and the manifestation of the ongoing interaction: humans' actions and impact, and the resulting reaction of their cultural settings. Culture and settings, tangible and intangible, could be monitored, traced, and assessed through communities' living patterns, behavior, and related social contexts and settings [1, 2].

The cultural setting is dynamic and ever-changing, along with the changes and transformations of the related communities; hence the proposition that culture and cultural settings are the means and tools to understand, read environments, and follow humans' adaptation to various environments [3, 4].

It is generally accepted that "culture" is an important factor in the life of societies, and an influence, determinant, and product [5, 6] that deserves attention and care in dealing with reading its components, levels, and products, tangible and intangible, and integrate into the processes of community and urban design and development.

The present work, addresses, culture, and cultural contexts as a key determinant in shaping communities' living, realizing sustainability, and securing continuity, and aspirations. Culture and components are recognized as a key dimension in "sustainable" development and drives, together with the complimentary dimensions, physical, environmental, and economic. It presents the notion of "spontaneous sustainability" of "distinct" communities that managed to continue, survive, and develop through time and till the present in their traditional settings, and away from, yet bearing and enjoying merits and returns, like those targeted by formal sustainability and development.

The present work is part of an extended study of the Nubian communities in Egypt, which witnessed major transformations through the past century and till the present, yet it maintained its distinct characteristics and values, reflected in its intact survival and continuity [7, 8]. The study investigates three distinct, existing, impressively functioning, and contrasting physical contexts, and related Nubian communities; arguably representing the said historic development from the turn of the twentieth century till now. A Nubian community still living in its original traditional setting, the second is a displaced community, in the new settlement, they moved to in the 1960s upon the construction of the "High Dam", Aswan, Egypt; and the third represents the migrated Nubian communities, that moved to and settled in major cities, as an alternative to settling in the newly developed displacement villages, Upper Egypt [9, 10].

This study will be covered in an independent presentation, a sequel to the present work, covering the said Nubian communities, and contexts, as well as the application of the proposed framework. Hence providing an appropriate forum for investigating "spontaneous sustainability" as an inherent social and cultural value, and allowing further development, and validation of the proposed "framework" for monitoring and enhancing spontaneous sustainability, the prime objective of the present work.

This research aims at formulating, developing, and validating the said "framework" for monitoring and supporting the "spontaneous sustainability" of distinct communities, enjoying historical depths, locales, and products to enable their integration into, and benefiting formal sustainable development frameworks and drives.

Literature review—on sustainability

The present work proposes and presents the conception, and features of "spontaneous sustainability", following the notion of societal "spontaneous" actions and reactions. Several concepts of "spontaneity" have emerged in urban contexts, that vary according to the circumstances and attitudes taken by communities, groups, and individuals. "Spontaneity" may be regarded as an "unplanned" act, motive, or an inborn tendency associated with unplanned physical settings shaped by "spontaneous" individual and

collective actions of a group or society that relates to the man-made urban and rural environments [11]. Closely related is what psychologists advocate, namely that "spontaneity" is an important feature of social relations among humans, leading to the realization of the personal nature of the individual.

Meanwhile, sociologists often adopt the view that "spontaneity" is a positive drive, feature, and characteristic, leading to development, and progress, and is based on a deep legacy of experience and learning, away from the social and economic motives that are closely intertwined with "spontaneity" [12].

As presented earlier in the "Introduction" section, this research presents "spontaneous sustainability" as an inherent value and feature of distinct societies and communities that managed to survive and develop through time. A value comprising respect and integration with their settings' resources and determinants, allowing them to enjoy the declared objectives of "formal sustainability", sustainable development, and drives, though often enough not targeted by or part of.

Hence, the emphasis on "culture", and its key aspects, criteria, and related indicators, in "sustainability" agendas, models, and drives, in this brief review. In preparation for the formulation of the targeted "framework" that allows following the research propositions, monitoring, and enhancing culturally distinct communities and settings, this section reviews in a determined sequence:

- Sustainability and sustainable development, the bases and backdrop of the proposed notion, together with,
- Sustainability models represent the complexity of the conception, and emphasize the emergence of "culture" as an added dimension and container, and,
- Urban sustainability systems, concluding the review, and presenting the comprehensive-most framework for sustainable development, emphasizing its dimensions, and effectively relating to designated physical settings, including districts and neighborhoods, as well as comprising key aspects, criteria, and indicators, and combining qualitative, and quantitative means of monitoring, and assessment, hence the relation and bases, it provides to the targeted "framework".

Sustainability and sustainable development

Sustainability is treated in contemporary discourses as a relatively new notion and drive, despite its intellectual and political developments through the past few decades and till the present. The emerging concept was shaped and developed, since its emergence, through the continuous debates, it witnessed and faced, and the related milestones of events and venues—yet it hardly enjoys consensus or adherence to its definition and scope [13, 14]. Humans' interaction with the environment to satisfy their needs and aspirations and facing the impact and returns was generally accepted as the key to and basis for the notion and conception of "sustainability" [15].

Sustainability is still a relatively vague concept open to multiple interpretations [16]. The early definition of the conception of sustainability and sustainable development, presented at the "Brundtland Commission" in 1987 is among the accepted-most,

namely "Development that fulfills the needs of the present without prejudice to the ability of future generations to fulfill their own needs" [17].

The conception and related notions and drives were invariably presented to comprise three main dimensions: social, environmental, and economic, that must be collectively addressed and satisfied, to secure sustainable development [18, 19]. It is generally agreed that "to consider the development of a given region, district, or a local setting "sustainable", it must integrate and achieve the qualities associated with the interactions of the said three key dimensions" [16].

Sustainability models

Many theoretical models representing sustainability were proposed to present and tame the complexity of the conception [19], including the widely used three intersecting circles' schematic diagram [13, 20]. The interactive circles represent the common-most dimensions (Fig. 1a); social, economic, and environmental to achieve sustainability and sustainable development goals, namely:

- Equitability (through economic and social dimensions' interactions).
- Livability (a product of environmental compatibility and social needs).

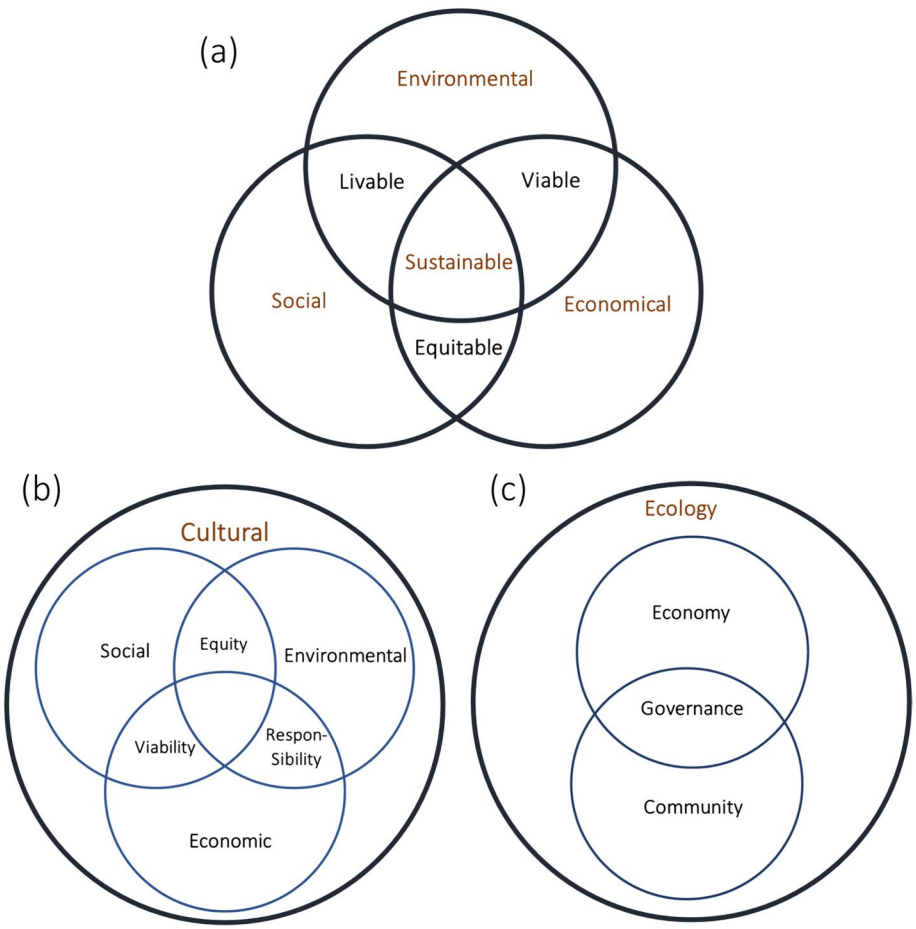

Fig. 1 Sustainability models and underlying propositions [15]

- Viability (harmony and integration, economic development, respecting and supporting environment and resources) [15].

"Culture" was later added as the fourth (Fig. 1b) to the three dimensions' circles, as a larger circle containing the earlier three key dimensions, and providing the context, and setting for [21]. Culture's importance was highlighted as it helps communities to "understand" their settings and environments, to follow, and comprehend related values and needs, and face the likely related challenges. Sabatini [22], emphasized that culture represents societies' links to the environment and settings, and the collective expression of the related physical and intangibles, values, needs, and challenges. Sabatini further indicated that culture encompasses the three development dimensions, and truly reflects the features characterizing societies [22].

Furthermore, sustainability representational models incorporated political and institutional dimensions (Fig. 1c) and hinted at the likely interactions between pairs of key dimensions adding to the earlier products, governance, effective management, decision-making, and (environmental fitting) ecology as means and features of effective sustainability process and implementation [13].

To reiterate, it can be generally accepted that sustainable development and sustainability depend on and combine the four dimensions (environmental, economic, socio-cultural, and institutional) in achieving its community-related objectives and securing betterment and quality of living.

Urban sustainability systems—selected approaches

Many urban sustainability systems were developed during the past two decades, combining key aspects, main indicators, and related criteria to assess the performance of "neighborhood sustainability", hence the title. NSA "Neighborhood Sustainability Assessment Systems Tools" was loosely classified into two subcategories, namely, systems and assessment "tools" related to the environmental performance of buildings and settings (spin-offs of building assessment tools), and systems, initiatives, and tools, related to neighborhood development plans and the sustainability performance of (Plan-Embedded Tools) [23, 24].

Urban sustainability rating tools may be regarded as "a stand-alone openly accessible act", providing quantitative elements for assessment of the extent of total and/or progressive welfare [25].

Furthermore, neighborhoods and settings plan-oriented rating tools including (LEED-ND) in the USA, (CASBEE-UD) in Japan, (BREEAM Communities) in the United Kingdom, (GREEN Star) in Australia, (The Pearl Community) in the United Arab Emirates, and (DGNB-UD) in Germany—provide a relatively balanced assessment of the environmental, social and economic dimensions, if compared to building level systems, that is arguably confined to the environmental aspect of the site [26, 27].

Table 1 represents the said six acclaimed urban sustainability assessment tools, systems, and initiatives (Kaur, H. and Garg, P. 2019) [26] pointing out: the state of origin, release dates, application scope, object's level, dimensions of sustainability, categories/themes, and number of criteria, relative weight, and performance rating measures.

Table 1 Features of selected "urban sustainability systems" (Kaur, H. and Garg, P. 2019) [26]

Sustainability tools	State of origin	Release dates			Application scope	Object's level	Categories/ themes	Dimensions of sustainability					No. of criteria	Relative weight	Performance rating measures
		Pilot phase	1st version	2nd version				Environmental	SocialSocialSocial		Economic	Institutional			
BREEAM Communities	U.K	2008	2009	2012	International	Community	Resources and energy	●					6	12.6	- Outstanding - Excellent - Very good - Good - Pass
							Land use and ecology	●					6	21.6	
							Transport and movement	●					7	13.8	
							Social and economic wellbeing-Local economy		●		●		2	42.7	
							Social and economic wellbeing—environmental conditions	●	●				6		
							Social and economic wellbeing—social wellbeing		●				9		
							Innovation					●	1	0	

Table 1 (continued)

Sustainability tools	State of origin	Release dates			Application scope	Object's level	Categories/ themes	Dimensions of sustainability				No. of criteria	Relative weight	Performance rating measures
		Pilot phase	1st version	2nd version				Environmental	SocialSocialSocial	Economic	Institutional			
							Governance				●	4	9.3	
LEED–ND	U.S.A	2007	2010	2014	International	Neighborhoods	Smart location and linkage	●				14	28	- Platinum - Gold - Silver - Certified
							Green infrastructure and buildings	●				21	31	
							Neighborhood pattern and design	●	●			18	41	
							Regional priority				●	1	4	
							Innovation and design process				●	2	6	
CASBEE-UD	Japan	2006	2007	2014	Continental	Group of Building	Nature	●				4	3	- Excellent - Very good - Good - Fairly poor - Poor
							Resource	●				4	3	
							Artifact (building)	●				1	3	
							Impartiality/ fairness		●			2	3	

Table 1 (continued)

Sustainability tools	State of origin	Release dates			Application scope	Object's level	Categories/ themes	Dimensions of sustainability				No. of criteria	Relative weight	Performance rating measures
		Pilot phase	1st version	2nd version				Environmental	SocialSocialSocial	Economic	Institutional			
							Safety/security	●	●			4	3	
							Amenity		●			4	3	
							Traffic/urban structure	●				4	3	
							Growth potential			●		3	3	
							Efficiency/ rationality			●		4	3	
							Co2 emissions at traffic sector	●				1	-	
							Co2 emissions at building sector	●				1	-	
							Co2 emissions at green sector	●				1	-	
Green Star	Australia	2012–2014	2015	-------	National	Community	Environment	●				11	47	- 1 star - 2 stars - 3 stars - 4 stars - 5 stars - 6 stars
							Design	●				4	27	
							Livability	●				7	35	

Table 1 (continued)

Sustainability tools	State of origin	Release dates			Application scope	Object's level	Categories/ themes	Dimensions of sustainability				No. of criteria	Relative weight	Performance rating measures
		Pilot phase	1st version	2nd version				Environmental	SocialSocialSocial	Economic	Institutional			
							Economic prosperity			●		8	38	
							Innovation				●	1	10	
							Governance				●	7	26	
DGNB System	Germany	2011	2012	2020	Continental	Urban District	Environmental quality	●				6	19	- Platinum - Gold - Silver - Bronze
							Economic quality			●		3	9	
							Sociocultural and functional quality		●			8	22	
							Technical quality	●				8	24	
							Process quality	●				9	23	
							Site quality		●			4	9	
The Pearl Community	United Arab Emirates	------	2010	2016	National	Community	Natural systems	●				8	14	- 1 pearl - 2 pearl - 3 pearl - 4 pearl - 5 pearl
							Precious water	●				8	37	

Table 1 (continued)

Sustainability tools	State of origin	Release dates			Application scope	Object's level	Categories/ themes	Dimensions of sustainability				No. of criteria	Relative weight	Performance rating measures
		Pilot phase	1st version	2nd version				Environmental	SocialSocialSocial	Economic	Institutional			
							Resourceful energy	●				42	42	
							Stewarding materials	●				11	18	
							Livable communities	●	●			16	38	
							Innovating practice				●	2	3	
							Integrated development process				●	8	10	

Methods

Propositions and methodology

Formulating the targeted "spontaneous sustainability" framework; to monitor, assess, enhance, and develop—is achieved through the deployment of established systems and agendas, addressing formal sustainability, integrating and developing, as well as synthesizing its components, key aspects, indicators, and criteria, emphasizing socio-cultural dimensions, and related scales of application, (validity) scope, towards the local and limited settings and communities.

Two related approaches provide the basis for the sequence of formulating the proposed framework, both focusing on sustainability assessment. The first is Diesendorf, M. (1998) [28], who emphasized, and pointed out the organic nature of the process, where sustainability resembles a "tree". His descriptive model comprises 4 consecutive levels, namely, the trunk (level 0) points out the ethical principles, (level 1) main branches, which represent the main goals and objectives, (level 2) secondary branches, which reflect the measurable objectives, and (level 3) combines the developed main and secondary branches, with the global development of "sustainability" goals and indicators, [29]. The second, is the framework, delineated by Jorge, G. (2013) [30], emphasizing five levels, namely, (1) sustainability dimensions, comprising main objectives and the three key dimensions (economic, social, and environmental), (2) urban sustainability issues, that need to be addressed to realize its objectives, including (resources, accessibility, survival, and viability), (3) evaluation criteria, related to the aspects needed to secure objectives and address sustainability issues to be evaluated, (4) design indicators, (levels to be achieved) the measures to assess design performance, comprising processes, and benchmarks, with specific units and measurement methods, and (5) criteria values, reference values and targets, [30].

Hence, "sustainability" monitoring and assessment frameworks should comprise, and integrate the said levels, namely:

> Dimensions of sustainability: environmental, economic, socio-cultural, and institutional.
> Key aspects: include and reflect the main themes and objectives for achieving urban "sustainability", as defined, and adopted by the United Nations and international agendas.
> Criteria: integrated and closely related to the key aspects, respected in the plans, policies, and drives to realize, and provide the means to assess and evaluate the performance of "sustainability" key aspects.
> Indicators: provide qualitative, and quantitative tools to evaluate, trace and assess the criteria.

The proposed "framework" for assessing the "spontaneous sustainability" of culturally distinguished communities, allowing monitoring, enhancing, and supporting; should combine, the said four levels and components, sustainability dimensions, key aspects, criteria, and related indicators.

It is formulated through a rational sequence, based on selected published work, presenting, reviewing, and integrating international approaches and agendas—open-ended so that it can be developed to include other approaches and agendas.

The formulation sequence

The proposed "framework" formulation sequence, comprises three interrelated phases, namely:

Phase 1: preliminary frameworks—selected international approaches

Reviewing, integrating, and collectively presenting a sample of selected leading sustainability systems and approaches, combining; dimensions, key aspects, criteria, and indicators. It comprises three independent stages in a rational sequence, namely:

Stage 1

Reviewing and collectivity representing selected international/global leading "Sustainability" systems and approaches, providing the start and bases for the target framework, (developed and presented between 2007 and 2015) (Tables 2 and 3).

Stage 2

Reviewing and collectivity presenting later global approaches, (developed and presented between 2014 and 2020), that checked and developed earlier endeavors, presented, and sampled in Stage 1 (Tables 4 and 5).

Stage 3

Reviewing and collectivity presenting selected later international frameworks, approaches, and systems, addressing social and cultural sustainability (developed and presented between 2015 and 2019) (Table 6).

Phase (2): integrating the preliminary frameworks, emphasizing social, and cultural dimensions

The preliminary formulation of the proposed "framework", integrates the products of phase (1) emphasizing sociocultural dimensions (Tables 7 and 8).

Phase (3): validation of the proposed framework

The validation procedure is an added step in the formulation of the targeted "framework", to point out the limitations, and potential, of the adopted conception, and methods—is carried out at this stage, through a pilot, limited survey, seeking the views of local experts (academics and professionals), allowing interaction, suggesting relative weights and importance, of key aspects and criteria, hence the development and presentation of the proposed "framework", and delineating directives of future related investigation, and research work. The selection criteria of the selected sample of experts are highlighted in the "The validation sample, participants' profiles" section.

Formulation of the proposed framework

This section briefly presents the selected sample of leading "sustainability" systems, agendas, and approaches, emphasizing sustainability 4 levels, and components, namely dimensions, key aspects, criteria, and indicators, hence allowing concentration and integration, and providing the bases for the targeted "framework".

Following the sequence, highlighted in the "Methods" section, namely:

Table 2 Sustainability assessment systems; environmental and economic dimensions–preliminary framework (1)

Sustainability dimensions	Main themes and aspects	Selected sustainability assessment systems						Impact level				Selectedkey aspects
								Macro		Micro		
		BREEAM Com. (2012) [31]	LEED-ND. (2011)	CASBEE-UD. (2007)	The Pearl Com. (2010)	GREEN Star. (2015)	DGNB System. (2012)	International	National	local	limited Scale	
Physical/environmental	Enhancement of ecological value || Minimized site disturbance in design and construction ||Preserving the environment ||Natural systems || Ecological enhancement || Local environment	●	●	●	●	●	●		✓	✓	✓	Local environment quality
	Sustainable buildings || Certified green buildings|| Environmentally friendly buildings || Sustainable buildings|| Green buildings || Quality of the building envelope	●	●	●	●	●	●			✓	✓	Sustainable green buildings
	Energy strategy || Solar orientation|| Use of effective energy || Use of effective energy || Renewable energy technologies	●	●	●	●	●	○	✓	✓	✓	✓	Energy strategy

Table 2 (continued)

Sustainability dimensions	Main themes and aspects	Selected sustainability assessment systems						Impact level				Selectedkey aspects
								Macro		Micro		
		BREEAM Com. (2012) [31]	LEED-ND. (2011)	CASBEE-UD. (2007)	The Pearl Com. (2010)	GREEN Star. (2015)	DGNB System. (2012)	International	National	local	limited Scale	
	Historic resource preservation and adaptive reuse‖ Consumption of local sources ‖Regional materials ‖ Materials ‖ Sustainable resource extraction	●	○	●	●	●	●		✓	✓	✓	Preservation resources
	Land use ‖Reuse of land‖ Site and context analysis	●	○	●	●	●	○			✓	✓	Land-use quality
	Microclimate ‖ Preserving the local climate ‖ Outdoor thermal comfort ‖ Adaptation and resilience ‖ Visual comfort	●	○	●	●	●	●		✓	✓	✓	Adaptation to climate
	Landscape‖ Efficient landscaping‖ Attention to the urban context‖ Natural systems protection‖ Protecting natural systems ‖ Influence on the district	●	●	●	●	●	●				✓	Efficient landscape

Table 2 (continued)

Sustainability dimensions	Main themes and aspects	Selected sustainability assessment systems						Impact level				Selectedkey aspects
								Macro		Micro		
		BREEAM Com. (2012) [31]	LEED-ND. (2011)	CASBEE-UD. (2007)	The Pearl Com. (2010)	GREEN Star. (2015)	DGNB System. (2012)	International	National	local	limited Scale	
	Preservation of topography‖ Site sensitivity‖ Urban planning and compliant planning	○	○	●	●	●	○		✓	✓	✓	Compatibility with nature
	Light and water pollution‖ Preventing environmental pollution ‖ Outdoor light pollution mitigation ‖ Light pollution‖ Acoustic and visual comfort	○	●	●	●	●	○	✓	✓	✓	✓	Environmental pollution
Economic	Economic impact‖ Economic growth‖ Economic development	●	○	●	●	○	○			✓	✓	Economic development
	Community management of facilities‖ Community investment	●	○	○	○	●	○			✓	✓	Community management
	Integrated development strategy‖ Employment and economic resilience‖ Flexibility and adaptability	○	○	○	●	●	●			✓	✓	Flexibility economic adjustment

Table 2 (continued)

Sustainability dimensions	Main themes and aspects	Selected sustainability assessment systems						Impact level				Selectedkey aspects
								Macro		Micro		
		BREEAM Com. (2012) [31]	LEED-ND. (2011)	CASBEE-UD. (2007)	The Pearl Com. (2010)	GREEN Star. (2015)	DGNB System. (2012)	International	National	local	limited Scale	
	Training and skills‖ Education and skills development	●	○	○	○	●	○				✓	Education and skills

Does cover/include aspect(s) (●), Does not cover/include aspect(s) (○)

Table 3 Sustainability assessment systems; social and cultural and institutional dimensions–preliminary framework (1)

Sustainability dimensions	Mainthemes and aspects	Selected sustainability assessment systems						Impact level				Selected key aspects
								Macro		Micro		
		BREEAM Com. (2012) [31]	LEED-ND. (2011)	CASBEE-UD. (2007)	The Pearl Com. (2010)	GREEN Star. (2015)	DGNB System. (2012)	International	National	local	limited Scale	
Social and cultural	Demographic needs and priorities || Comfort in daily life ||Life cycle costing ||Healthy and active living|| Life cycle cost	●	○	●	●	●	●			✓	✓	Demographic needs and quality life
	Delivery of services, facilities || Amenities|| Provision of services || Access to amenities	●	○	●	●	●	●			✓	✓	Services and amenities
	Transit supportive practices and connectivity|| Accessibility and adaptability|| Mobility infrastructure	○	○	○	●	●	●			✓	✓	Connectivity/ pedestrian network
	Safe and appealing streets|| Preventive performance against|| Disasters and crime|| Safe Places|| Safety and security	●	○	●	○	●	●		✓	✓	✓	Safety

Table 3 (continued)

Sustainability dimensions	Mainthemes and aspects	Selected sustainability assessment systems						Impact level				Selected key aspects
								Macro		Micro		
		BREEAM Com. (2012) [31]	LEED-ND. (2011)	CASBEE-UD. (2007)	The Pearl Com. (2010)	GREEN Star. (2015)	DGNB System. (2012)	International	National	local	limited Scale	
	Public realm (social activities) || Management of pedestrian areas || Active urban environments || Quality of indoor and outdoor spaces	●	○	●	●	○	●			✓	✓	Public realm quality
	Local vernacular|| Innovative cultural and regional practices|| Culture, heritage, and identity	●	○	●	●	●	○		✓	✓	✓	Identity culture heritage
	Socialization|| Livable spaces || Design for all	○	●	●	●	○	○			✓	✓	Social livable spaces
	Sustainable food practice|| Access to fresh food	○	●	○	●	○	○		✓	✓	✓	Sustainable access food
Institutional	Consultation and engagement|| Public participation|| Transit supportive practices and connectivity|| User communication	●	○	●	●	●	●	✓	✓	✓	✓	Consultation and public participation

Table 3 (continued)

Sustainability dimensions	Mainthemes and aspects	Selected sustainability assessment systems						Impact level				Selected key aspects
								Macro		Micro		
		BREEAM Com. (2012) [31]	LEED-ND. (2011)	CASBEE-UD. (2007)	The Pearl Com. (2010)	GREEN Star. (2015)	DGNB System. (2012)	International	National	local	limited Scale	
	Sustainability awareness	○	○	○	●	●	○	✓	✓	✓	✓	Sustainability awareness
	Innovating practice ‖ Innovation	○	○	○	●	●	○		✓	✓	✓	Innovating practice

Does cover/include aspect(s) (●), Does not cover/include aspect(s) (○)

Table 4 Developing sustainability assessment systems; environmental dimensions—preliminary framework (2)

Sustainability dimensions	Aspects and criteria		Selected approaches			Impact level				Selected key aspects and criteria	
						Macro		Micro			
			Sustainability Circles. (2014)	CAMSUD. (2020)	USAT. (2019)	International	National	local	Limited Scale		
	Categories	Criteria								Key aspects	Criteria
Physical/environmental	Habitat and settlements‖ Site location /site ecology‖ Ecology	Site selection	●	●	●		✓	✓	✓	Site environment and settlements	Site selection
		Preserving the site's environment	●	●	●		✓	✓	✓		Preserve the site environment
		Housing and settlement pattern	●	●	●		✓	✓	✓		Housing and settlement pattern
	Materials and energy‖ Resources‖ Resources and energy	Solar guidance	●	●	●			✓	✓	Resources and energy	Solar guidance
		Resource efficiency	●	●	●		✓	✓	✓		Resource efficiency
		Renewable energy	●	●	●	✓	✓	✓			----------
		Sustainable construction	●	●	●		✓	✓	✓		Sustainable construction
		Reuse of buildings	●	●	●		✓	✓	✓		Reuse buildings
	Land use‖ Land use and green infrastructure	Land use distribution	○	●	●			✓	✓	Land uses	Land use distribution
		Urban density	○	●	●			✓	✓		Urban density
		Urban cohesion	○	●	●			✓	✓		Urban cohesion

Table 4 (continued)

Sustainability dimensions	Aspects and criteria		Selected approaches			Impact level				Selected key aspects and criteria	
						Macro		Micro			
			Sustainability Circles. (2014)	CAMSUD. (2020)	USAT. (2019)	International	National	local	Limited Scale		
	Categories	Criteria								Key aspects	Criteria
		Mixed-use	○	●	●			✓	✓		Mixed-use
		Housing diversity	○	●	●			✓	✓		Housing diversity
		Flexibility of use	○	●	●			✓	✓		Flexibility of use
		Hierarchy of open spaces	○	●	●			✓	✓		Hierarchy of open spaces
		Green building	○	●	●			✓	✓		Green building
	Built-form and transport‖ Infrastructure/ transport‖ Transportation and connectivity‖ Amenity	Urban network	●	●	●		✓	✓		Transport infrastructure	⁀|———————-
		Proximity and access	●	●	●			✓	✓		Proximity and access
		Pedestrian paths	●	●	●				✓		Pedestrian paths
		Mass and public transport	●	●	●			✓	✓		Mass and public transport
		Public and private traffic networks	●	○	○	✓	✓	✓	✓		Public and private traffic networks

Table 4 (continued)

Sustainability dimensions	Aspects and criteria		Selected approaches			Impact level				Selected key aspects and criteria	
						Macro		Micro			
			Sustainability Circles. (2014)	CAMSUD. (2020)	USAT. (2019)	International	National	local	Limited Scale		
	Categories	Criteria								Key aspects	Criteria
	Water and air‖ Urban climate and climate change‖ Climate and comfort in outdoor areas	Adaptation to climate	●	●	●		✓	✓	✓	Local climate	Adaptation to climate
		External thermal comfort	●	●	●		✓	✓	✓		External thermal comfort
		Prevention of pollution	●	●	●		✓	✓	✓		Prevention of pollution

Does cover/include aspect(s) and criteria (●), Does not cover/include aspect(s) and criteria (○)

Table 5 Developing sustainability assessment systems: economic, social, culture, and institutional dimensions—preliminary framework (2)

Sustainaility dimensions	Aspects and criteria		Selected approaches			Impact level				Selected key aspects and criteria	
						Macro		Micro			
	Aspects	Criteria	Sustainability circles (2014)	CAMSUD. (2020)	USAT. (2019)	International	National	local	limited Scale	Key aspects	Criteria
Economic	Production and resourcing‖ Economy‖ Economic impact	Prosperity and resilience	●	●	●	✓	✓	✓	✓	Economic impact	Prosperity and resilience
		Art and crafts	●	●	●	✓	✓	✓	✓		Art and crafts
		Production and manufacturing	●	●	●	✓	✓	✓	✓		Production and manufacturing
	Labor and welfare |Economic structure	Participation and equality	●	○	●	✓	✓	✓	✓	Economic structure	Participation and equality
		Employment opportunities	●	○	●	✓	✓	✓	✓		Employment opportunities
		Life cycle cost	●	○	●	✓	✓	✓	✓		Life cycle cost
Social	Consumption and use and well-being health ‖ Social and health wellbeing	Basic needs	●	○	●	✓	✓	✓	✓	Viability	Basic needs
		Providing housing	●	○	●	✓	✓	✓	✓		Providing housing
		Services and facilities	●	○	●	✓	✓	✓	✓		Services and facilities

Table 5 (continued)

Sustainaility dimensions	Aspects and criteria		Selected approaches			Impact level				Selected key aspects and criteria	
						Macro		Micro			
	Aspects	Criteria	Sustainability circles (2014)	CAMSUD. (2020)	USAT. (2019)	International	National	local	limited Scale	Key aspects	Criteria
	Habitat and settlements‖ urban network, accessibility‖ Urban layout, pattern, and design	Easy access and communication	●	○	●	✓	✓	✓	✓	Housing pattern and urban design	Easy access and communication
		Diversity of housing patterns	●	○	●	✓	✓	✓	✓		Diversity of housing patterns
		Proximity of housing and work	●	○	●	✓	✓	✓	✓		Proximity of housing and work
		Access to public, civic, and leisure spaces	●	○	●	✓	✓	✓	✓		Access to public, civic, and leisure spaces
	Security and accord ‖ Safety and security‖ Safety	Safe and secure communities	●	●	●	✓	✓	✓	✓	Safety and security	Safe and secure communities
		Insurance and social security	●	●	●	✓	✓	✓	✓		Insurance and social security
		Safe design for open spaces and streets	●	●	●	✓	✓	✓	✓		Safe design for open spaces and streets
	Identity engagement, creativity and recreation‖ Visual aesthetic significance	Visual scene	●	○	●	✓	✓	✓	✓	Visual significance	Visual scene

Table 5 (continued)

Sustainaility dimensions	Aspects and criteria		Selected approaches			Impact level				Selected key aspects and criteria	
						Macro		Micro			
	Aspects	Criteria	Sustainability circles (2014)	CAMSUD. (2020)	USAT. (2019)	International	National	local	limited Scale	Key aspects	Criteria
		Sense of identity of place	●	○	●	✓	✓	✓	✓		Sense of identity of place
		Natural contexts	●	○	●	✓	✓	✓	✓		Natural contexts
		Harmonization with periphery	●	○	●	✓	✓	✓	✓		Harmonization with periphery
Culture	Memory, projection, creativity, recreation and belief, and meaning‖ Society‖ Local community cultural and heritage	Background and impact	●	○	●		✓	✓	✓	Identity and cultural upbringing	Background and impact
		Cultural inheritance and heritage	●	○	●	·	✓	✓	✓		Cultural inheritance and heritage
		Community and place affiliation	●	○	●	·	✓	✓	✓		Community and place affiliation
		Social infrastructure	●	○	●	·	✓	✓	✓		Social infrastructure
Institutional	Organization and governance and law and justice‖ Governance	Transparency and clarity	●	○	●	·	·	✓	✓	Governance and justice	Transparency and clarity
		Community participation	●	○	●	·	·	·	✓		Community participation
		Equality and respect	○	○	●	·	·	·	✓ل		Equality and respect

Does cover/include aspect(s) and criteria (●), does not cover/include aspect(s) and criteria (○)

Table 6 Social and cultural sustainability: selected approaches—preliminary framework (3)

Sustainability dimensions	Aspects and criteria		Selected studies				Impact level				Selected key aspects and criteria	
			Kefayati, Z. (2015) [32]	Hajirasouli, A. (2016) [33]	Mehan, A. (2017) [34]	Doğu, F. U. (2019) [35]	Macro		Micro			
	Aspects	Criteria					International	National	local	limited Scale	Key aspects	Criteria
Social and cultural	Basic human needs ‖ Physical well-being‖ Satisfaction of human needs	Physiological needs	●	●	○	○	✓	✓	✓	✓	Basic human needs	Physiological needs
		Healthy living and education	●	●	●	○	✓	✓	✓	✓		Healthy living and education
		Providing adequate housing	●	●	●	○	✓	✓	✓	✓		Providing adequate housing
	Social interaction‖ Social mixing‖ Coherence and social cohesion‖ Cohesion and interactions	Connected and open societies	●	●	○	●	✓	✓	✓	✓	Cohesion and social interactions	Connected and open societies
		Social relations and networks	●	●	●	●	✓	✓	✓	✓		Social relations and networks
	Flexibility‖ Flexibility and satisfaction	Social formations and cultural patterns	●	○	○	●	✓	✓	✓	✓	Flexibility and satisfaction	Social formations and cultural patterns
	Social security‖ Safety needs‖ Social equity	Crime prevention	●	●	○	○	✓	✓	✓	✓	Safety and security	Crime prevention
		Sense of security	●	○	○	●	✓	✓	✓	✓		Sense of security

Table 6 (continued)

Sustainability dimensions	Aspects and criteria		Selected studies				Impact level				Selected key aspects and criteria	
			Kefayati, Z. (2015) [32]	Hajirasouli, A. (2016) [33]	Mehan, A. (2017) [34]	Doğu, F. U. (2019) [35]	Macro		Micro			
	Aspects	Criteria					International	National	local	limited Scale	Key aspects	Criteria
	Architectural identity‖ Culture of community‖ Cultural identity	Aesthetics of architecture and urbanism	●	○	○	○	✓	✓	✓	✓	Architectural and cultural identity	Aesthetics of architecture and urbanism
		Cultural practices (physical and non-physical)	●	○	●	○	✓	✓	✓	✓		Cultural practices (physical and non-physical)
		Activities and celebrations	●	○	●	○	✓	✓	✓	✓		Activities and celebrations
	Social capital‖	Social affiliation/ adherence to place	●	●	○	●	✓	✓	✓	✓	Social capital	Social affiliation/ adherence to place
	Social capital and wellbeing	Intangible cultural heritage	●	●	○	●	✓	✓	✓	✓		Intangible cultural heritage
		Civic participation	●	●	○	●	✓	✓	✓	✓		Civic participation
		Socialization	●	●	○	●	✓	✓	✓	✓		Socialization
	Belonging and commitment to place ‖Sense of place‖ Sense of belonging	Community stability	○	○	○	●	✓	✓	✓	✓	Sense of belonging	Community stability
		Sense of community	●	○	○	●	✓	✓	✓	✓		Sense of community
		Sense of place	●	●	●	●	✓	✓	✓	✓		Sense of place

Table 6 (continued)

Sustainability dimensions	Aspects and criteria		Selected studies				Impact level				Selected key aspects and criteria	
			Kefayati, Z. (2015) [32]	Hajirasouli, A. (2016) [33]	Mehan, A. (2017) [34]	Doğu, F. U. (2019) [35]	Macro		Micro			
	Aspects	Criteria					International	National	local	limited Scale	Key aspects	Criteria
		Sense of belonging to the house	○	○	○	●	✓	✓	✓	✓		Sense of belonging to the house
	Social participation‖ Communication and participation	Social mixing/ communication and integration	●	●	○	○	✓	✓	✓	✓	Social participation	Social mixing/ communication and integration
	Quality of life	Privacy	○	○	●	○	✓	✓	✓	✓	Quality of life	Privacy
		Comfort in everyday life	●	○	●	○	✓	✓	✓	✓		Comfort in everyday life
		Satisfaction with basic facilities and services	●	●	○	○	✓	✓	✓	✓		Satisfaction with basic facilities and services
		The social, environmental, and economic wellbeing	○	○	○	○	✓	✓	✓	✓		The social, environmental, and economic well-being

Table 7 Integrating the preliminary frameworks 1 and 2—sustainability assessment systems, and development

Sustainability dimensions	**Sustainability systems Stage (1)**	**Sustainability systems' development Stage (2)**		**Integrated Preliminary Frameworks (1) and (2) Sustainability key aspects and criteria**	
	Key aspects	**Key aspects**	**Criteria**	**Key aspects**	**Criteria**
Physical/environmental	Local environment quality	Site environment and settlements[c]	Site selection	Local environment and settlements	Appropriate location
			Preserve the site environment		Location quality
			Housing and settlement pattern		
	Sustainable green buildings[a]				
	Energy strategy	Resources and energy[b]	Solar guidance	Resources and energy	Solar guidance
	Conservation sustainable resources		Resource efficiency		Resource efficiency
			Sustainable construction		Sustainable construction
			Reuse buildings		Reuse buildings
	Land-use quality	Land uses[b]	Land use distribution	Land uses	Overlap and diversity of land uses
			Urban density		
			Urban cohesion		Urban density
			Mixed-use		
			Housing diversity		Urban cohesion
			Flexibility of use		
			Hierarchy of open spaces		The hierarchy of open spaces
			Green building		
	–––––––––	Transport infrastructure[c]	Proximity and access	Mobility structure	Urban network
			Pedestrian paths		Proximity and accessibility to the transportation network
			Mass and public transport		
			Public and private traffic networks		
	Adaptation to climate	Local climate[b]	Adaptation to climate	Local climate adaptation	Climate adaptation
			External thermal comfort		
			Prevention of pollution		Prevention of pollution
	Efficient landscape				

Table 7 (continued)

Sustainability dimensions	Sustainability systems Stage (1)	Sustainability systems' development Stage (2)		Integrated Preliminary Frameworks (1) and (2) Sustainability key aspects and criteria	
	Key aspects	Key aspects	Criteria	Key aspects	Criteria
	Compatibility with nature				
	Environmental pollution				
Economic	Economic development	Economic impact[b]	Prosperity and resilience	Economic structure and adjustment	Using local sources and resources
	Community management		Art and crafts		
			Production and manufacturing		
	Flexibility and economic adjustment	Economic structure[b]	Participation and equality		Local community contribution
	Education and skills		Employment opportunities		
			Life cycle cost		
Social and cultural	Demographic needs and quality life	Viability[b]	Basic needs	Viability (social and health)	Demographic needs/basic
	Services and amenities		Providing housing		Health care and education
					Housing stability
			Services and facilities		Services and facilities
	Connectivity/ pedestrian network	Pattern and urban design[c]	Easy access and communication	Urban design patterns	Accessibility and communication
			Diversity of housing patterns		
			Proximity of housing and work		Diversity of housing patterns
			Access to public, civic, and leisure spaces		Proximity of housing and work
	Safety	Security and safety[b]	Safe and secure communities	Safety and security	Social insurance and security
			Insurance and social security		
			Security design for open spaces and streets		
	Public realm quality	Visual significance[b]	Visual scene	Urban value	Visual and aesthetic value
			Sense of the identity of the place		
			Natural contexts		
			Harmonization with periphery		Harmonization with periphery

Table 7 (continued)

Sustainability dimensions	Sustainability systems Stage (1)	Sustainability systems' development Stage (2)		Integrated Preliminary Frameworks (1) and (2) Sustainability key aspects and criteria	
	Key aspects	Key aspects	Criteria	Key aspects	Criteria
	Identity culture heritage	Identity and cultural upbringing[b]	Background and impact	Cultural identity	Assets and background
			Cultural inheritance and heritage		Heritage and cultural identity
			Community and place affiliation		Sense of social belonging
			Social infrastructure		
	Social livable spaces[a]				
	Sustainable access to food[a]				
Institutional	Consultation and Public participation	Governance and justice[b]	Transparency and clarity	Governance and public participation	Community awareness
			Community participation		Participation and interactions in social roles
			Equality and respect		
	Sustainability awareness[a]				
	Innovating practice[c]				

[a] Excluded in the "development" 3-approaches—preliminary framework (2)

[b] Overlapping key aspects

[c] Added key aspects in the "development" 3-approaches—preliminary framework (2)

- Leading sustainability assessment systems (2007–2015).
- Developing sustainability systems influenced by the said leading systems (2007–2015).
- Social and cultural sustainability assessment; the focus of the propositions and target "framework" (2014–2020).

The emphasis in this section is on the method and rationale, the integration of the selected agendas and approaches' components, and key notions of the presented frameworks, ready for validation and further assessment; more systems and agendas could be checked and integrated in future research.

Preliminary frameworks (phase 1)—proposed framework formulation

Sustainability assessment framework (stage 1)—selected systems and approaches

As hinted earlier, stage 1 presents and highlights selected international urban sustainability assessment, systems, published and widely deployed. The six sustainability systems

Table 8 Integrating the preliminary frameworks (1), (2), and (3)

Sustainability dimensions	Social and cultural sustainability, selected approaches–preliminary framework (3)		Preliminary frameworks (1 and 2) Key aspects and criteria		Integrated preliminary frameworks (1, 2, and 3), emphasizing social and cultural- (key aspects and criteria)	
	Key aspects	Criteria	Key aspects	Criteria	Key aspects	Criteria
Social and cultural	Basic human needs	Physiological needs	Viability (social and health)	Demographic needs/basic	Viability (social and health)	Physiological needs
		Healthy living and education		Health care and education		Health care and education
		Providing adequate housing		Housing stability		Providing adequate housing/housing stability
				Services and facilities		Services and facilities
	Cohesion and social interactions	Connected and open societies	Urban design patterns	Accessibility and communication/	Urban design patterns	Accessibility and communication
		Social relations and networks		diversity of housing patterns		Diversity of housing patterns
	Flexibility and satisfaction	Social formation and cultural patterns		Proximity of housing and work		Proximity of housing and work
						Social formation pattern
	Safety and security	Crime prevention	Safety and security	Social insurance and security	Safety and security	Social insurance and security
		Sense of security				Sense of security
	Architectural and cultural identity	Aesthetics of architecture and urbanism	Urban value	Visual and aesthetic value	Urban value	Visual and aesthetic value
				Harmonization with periphery		Sense of belonging

Table 8 (continued)

Sustainability dimensions	Social and cultural sustainability, selected approaches–preliminary framework (3)		Preliminary frameworks (1 and 2) Key aspects and criteria		Integrated preliminary frameworks (1, 2, and 3), emphasizing social and cultural- (key aspects and criteria)		
	Key aspects	Criteria	Key aspects	Criteria	Key aspects		Criteria
		Cultural practices (physical and non-physical)	Cultural identity	Assets and background	Cultural identity		Assets and background
				Heritage and cultural identity			Heritage and cultural identity
		Activities and celebrations		Sense of social belonging			Socio-cultural practices
							Aesthetics of urbanism and architecture
	Social capital	Social affiliation/ adherence to place			Social capital	Social commitment and socialization	
		Intangible cultural heritage					
		Civic participation					
		Socialization					
	A sense of belonging	Community stability				Sense of social belonging	
		Sense of community					
		Sense of place					
		Sense of belonging to the house					

Table 8 (continued)

Sustainability dimensions	Social and cultural sustainability, selected approaches–preliminary framework (3)		Preliminary frameworks (1 and 2) Key aspects and criteria		Integrated preliminary frameworks (1, 2, and 3), emphasizing social and cultural- (key aspects and criteria)	
	Key aspects	**Criteria**	**Key aspects**	**Criteria**	**Key aspects**	**Criteria**
	Social participation	Consultation and participation			Social mixing and participation	
		Social mixing				
	Quality of life	Privacy and comfort in everyday life				
		The social, environmental, and economic well-being of citizens				

presented delineate the approach to shaping and formulating the preliminary framework, highlighting similarities and agreement and providing the bases for the formulation of the targeted framework—other systems could be further added and compared. Tables 2 and 3 present the six selected systems, preliminary framework (1), pointing out the main features, according to the four levels indicated earlier; namely sustainability dimensions, likely impact (spatial) level, representative common selected key aspects, hence suggesting similarities and agreement and providing the bases for formulation of the concluding framework. The selected systems are the following:

- BREEAM Communities [31].
- LEED for Neighborhood Development [36].
- CASBEE for Urban Development [37].
- GREEN Star Community Rating System [38].
- The Pearl Communities Rating System [39].
- DGNB-UD Rating System [40].

Developing sustainability assessment systems framework (stage 2)—three selected approaches

Following the review, presentation, and highlight of the six sustainability assessment systems pointing out main features according to the sustainability dimensions, indicating themes, impact spatial level, and key aspects, this section presents a sample of the follow-up studies based on and influenced by the earlier agendas (5 years apart), synthesizing, and further developing.

It follows the structure and contents of the earlier systems, emphasizing developed criteria to check and enhance main/key aspects, and attempting to focus on the emerging challenges. The three follow-up updating studies are the following:

- Sustainability Circles Method [41].
- Comprehensive Assessment Method for Sustainable Urban Development (CAMSUD) [42].
- Urban Sustainability Assessment Tools (USAT) [26].

1) Sustainability circles method [41]:

   A method developed through collaboration among Metropolis, the United Nations, and other organizations, as a part of the Social Life Circles Project, led by Paul James and Liam Magee. The circles are used to review and assess "sustainability", and manage socially sustainable worldwide projects, places, and settings. This method is mostly used for urban areas and settlements. The circle is divided into four domains, namely the environment, the economy, politics, and culture; each domain is further divided into seven sub-domains [41].
2) Comprehensive Assessment Method for Sustainable Urban Development CAMSUD [42]:

The "Comprehensive Assessment Method for Sustainable Urban Development", CAMSUD, was introduced in 2017; the result of an extensive comparative analysis of five well-established urban sustainability assessment systems, namely: CASBEE-UD, LEED-ND, BREEAM Communities, DGNB-NSQ, and Green Star Community. The comparison identified agreement, similarities, and differences among those systems, and potential for further improvement, in the light of the outstanding points of strength and weakness. It further introduced the main concepts, common in its development, in addition to some 40 criteria as the specific goals of sustainability; classified into 8 categories, to achieve sustainability [42].

3) Urban Sustainability Assessment Tools USAT [26]:
This approach is similarly based on a comprehensive review of six of the common-most deployed urban sustainability assessment tools, namely: Building Research Establishment Environmental Assessment Method (BREEAM Communities), Comprehensive Assessment System for Built Environment Efficiency (CASBEE) for Urban Development, Green Building Index (GBI) for Cities, Leadership in Energy and Environmental Design (LEED) for neighborhoods' development, the Indian Green Building Council (IGBC) for green cities, and the Green Rating for Integrated Habitat Assessment (GRIHA). It pointed out similarities and differences and identified gaps and capabilities in appropriately addressing urban sustainability assessment issues in various contexts [26].

Tables 4 and 5 sum up stage (2)—collectively present preliminary framework (2), developing sustainability systems, highlighting the features of the selected three studies and related systems, adhering to the entries, and classifying into dimensions, main aspects, criteria, and hinting at similarities and agreements, and indicating selected key aspects and criteria, likely to relate to limited scale settings and communities.

Social and cultural sustainability assessment; selected approaches—preliminary framework (stage 3)

This section concludes phase 1, presenting selected sample research work, addressing, monitoring, and assessing social and cultural sustainability towards the formulation of the proposed framework to monitor and enhance spontaneous sustainability comprising four selected approaches to emphasize the method (more could be incorporated later) loosely following and adhering to the factors identified by Nicola Dempsey et al. [43, 44]), namely:

- Kefayati, Z. and Moztarzadeh, H., [32].
- Hajirasouli, A. and Kumarasuriyar, A., [33].
- Mehan, A. and Soflaei, F., [34].
- Doğu, F. U. and Aras, L., [35].

1) Kefayati, Z. and Moztarzadeh, H. 2015 presented and addressed principles and criteria for assessing societal sustainability including social interaction, architectural identity, social security, flexibility, and social participation, together with indicators of social sustainability in urban design that are likely to be closely related to social

interactions and collective memory, attachment, belonging, and commitment to places [32].

2) Hajirasouli, A. and Kumarasuriyar, A. 2016 related social sustainability topics and issues to macro and micro (spatial) levels, namely:
   Macro levels refer to material welfare and basic needs of communities and individuals including shelter/housing, food, clothing, and public facilities.
   Micro levels include quality of life and equity (social and cultural life, coherence and social cohesion, integration, diversity and sense of place, communication and participation, equity and social justice, social stability, social security, social capital, and welfare) [33].

3) Mehan, A. and Soflaei, F. 2017 recognized and presented definitions, principles, and frameworks of social sustainability, highlighting key aspects affecting it, in urban settings, and satisfying the community's needs. Suggested key aspects of social sustainability, including social equity, satisfying human needs, social interaction, cohesion and integration, sense of place, cultural identity, and quality of life [34].
4) Doğu, F. U. and Aras, L. 2019 proposed a rationale, an MCSA model, to follow and assess social sustainability in urban settings, comprising a number of key aspects, including social interactions, security, perceived environment, social capital, sense of belonging, and satisfaction. Those aspects are addressed through related variables and criteria [35].

Table 6, preliminary framework (3), collectively presents the key aspects and criteria, put forward by the (sample) four selected approaches, stressing the commonmost and representative to be later integrated into the earlier two relational tables: preliminary frameworks (1) and (2).

Integrating the preliminary frameworks, emphasizing socio-cultural dimensions—the proposed framework (phase 2)

This section follows the briefly highlighted method ("Methods" section), towards the formulation of the target, proposed "framework" for monitoring and enhancing "spontaneous sustainability", emphasizing the socio-cultural dimensions. The formulation drive deploys the three preliminary frameworks, presented in phase 1, in three stages, namely:

- Preliminary framework (1): sustainability assessment systems (Tables 2 and 3).
- Preliminary framework (2): developing sustainability assessment systems (Tables 4 and 5).
- Preliminary framework (3): social and cultural sustainability (Table 6).

The formulation is carried out in a rational sequence, combining and integrating the products, key aspects, and criteria of the three preliminary frameworks in three steps, leading to the presentation of the "proposed framework".

Formulation of the proposed framework—step 1

Integrating the products of stages 1 and 2, sustainability assessment systems and development, the preliminary frameworks 1 and 2—comprising the six sample approaches, relational (Tables 2 and 3), together with the three "sustainability assessment systems" development approaches, preliminary framework 2, and relational tables (Tables 4 and 5). Table 7 represents the said integration, through the governing notions and components, sustainability levels, dimensions, key aspects, and related criteria.

This is collectively carried out, for stages 1 and 2, and combined in the integrated preliminary frameworks 1 and 2, sustainability key aspects, and criteria. The integrated set combines common aspects and related criteria of sustainability assessment systems and development (12 key aspects, and 31 criteria).

Formulation of the proposed framework—step 2

Integrating the products of stages 1, 2, and 3, sustainability assessment systems and development emphasizing the socio-cultural dimensions. This is carried out in a rational sequence, integrating the selected key aspects and related criteria of the preliminary framework 3, social and cultural sustainability sample approaches (Table 6) with the collective socio-cultural product of integrating preliminary frameworks 1 and 2, (Table 7).

Table 8 represents the integrating sequence, the key aspects, and related criteria of preliminary framework 3, the combined frameworks 1 and 2, and the collective combination of the 3 preliminary frameworks, namely, the integrated social and cultural sustainability, key aspects, and criteria.

Formulation of the proposed framework—step 3: spontaneous sustainability, framework 1

This is carried out by combining the products of integrating frameworks 1, 2, and 3, and the integrated key aspects, and related criteria.

Table 10 presents the said combination: sustainability dimensions, collective key aspects, criteria, and related indicators, emphasizing the social and cultural. Furthermore, an added evaluation scale for assessing the relative weight and importance of the criteria and related indicators. This will allow the presentation of the "proposed framework" to the validation sample of experts, academics, and practitioners/professionals, as an integral part of phase 3 of the formulation of the proposed framework (Sec. 3., Propositions and Methodology).

Validation of the proposed framework (phase 3)

The validation of the proposed "framework" for monitoring and enhancing "spontaneous sustainability", is an integrated part of its development, as indicated in the "Methods" Sect. (3), (phase 3), and Fig. 2. The "proposed framework" (Table 10) and the closely related underlying propositions, the formulation sequence, and preliminary frameworks 1, 2, and 3), were presented to a limited sample of local experts, academics, and professionals, combining research and practice experience, in the present work realms and related fields, namely, architecture, urban design and planning, community design and development, landscape design, as well as social and cultural studies. The validation was

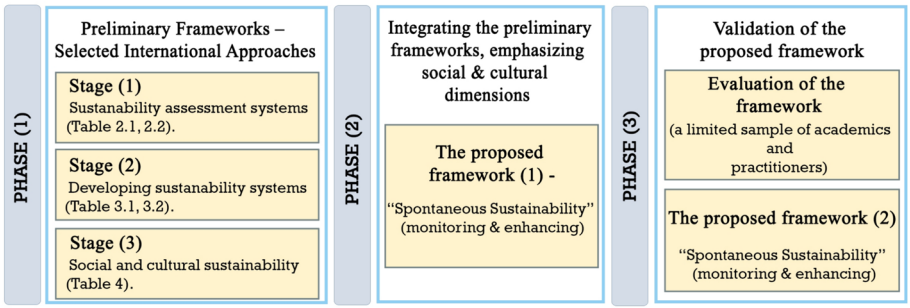

Fig. 2 Formulation of the proposed "spontaneous sustainability" monitoring and assessment "framework"—phases and stages

based on a questionnaire, backed by the adopted method presentation (phases, stages, and steps), the preliminary frameworks 1, 2, and 3, and the resulting "proposed framework" (Table 10) to be evaluated by the participating experts.

The validation questionnaire and supporting research material comprised and covered four key components and the underlying objectives are the following:

1) The validation sample, participants; key data, profiles, specialization, and years of experience.
2) The present research "propositions" and method of formulating the targeted "Framework", together with the preliminary frameworks 1, 2, and 3 (Tables 2, 3, 4, 5, and 6).
3) The "proposed framework" for monitoring and enhancing "spontaneous sustainability" (Table 10).
4) The sample participants' interaction with the "proposed framework" suggests the importance and relative weights of its components: key aspects, criteria, and indicators (Table 11).

The outcome of the preliminary validation parts and objectives is briefly presented in the following sub-sections.

The validation sample, participants' profiles

The validation sample comprised 25 participants, of specialists; academics, and professionals/practitioners, and mostly spanning both.

The selection criteria of the sample combined the fields of specialization closely related to the present research scope: architecture, urban design and planning, community design and development, and landscape design, supported by specialists in social sciences and humanities—all with at least 5 years of experience. The validation sample was mostly academic, with professional experience, and their main features/profiles, as briefly presented in Table 9.

Research propositions

The participants invariably accepted the present work, key propositions, and underlying notions, namely:

– The notion of "spontaneous sustainability".

Table 9 The validation sample participants; academics, and professionals/practitioners—main features

Position title		Areas of specialization					Years of experience (academic and practical)		Respondents
		Architecture	Urban design and community development	Urban planning	Landscape design	Social sciences and humanities	Up to 5 years	More than 5 years	
Academics	Professors	√	√	√		√		●	8
	Associate professors	√	√					●	4
	Lecturers	√	√		√			●	5
Practitioners and professionals	Master's degree	√				√	●	●	3
	Ph.D. degree	√						●	5
Total									25

– Culture as the container, and social and cultural dimensions of sustainability, impact, and relative importance.
– "Spontaneous Sustainability" likely contribution to formal Sustainability systems and drives.

Spontaneous sustainability framework development

The participants agreed with and endorsed the research procedure to realize the research objective, and the sequence to formulate the targeted "proposed framework', through the three stages and products, "sustainability assessment systems", "development approaches", and "social and cultural sustainability", and integrating the resulting three "preliminary frameworks". They also accepted the format of the resulting "proposed framework", pointing out its clarity, ease of usage, practicality, and flexibility. Furthermore, the participants interacted with it, assessing, and suggesting the relative weights and importance of its key components: key aspects, criteria, and indicators.

Interacting with the proposed framework

Guided by their combined experience, academic and practical, the participants were asked to deploy and interact with the "proposed framework", indicating the relative weights and importance of the key aspects, each criterion, and related indicators, in achieving, "spontaneous sustainability" using Saaty, T. (1994) [45], relative weighting and importance, 9 ranks/levels scale, ranging from least important (1) to the top-most (9).

Results and discussion

The results of the questionnaire were compiled, presented, and analyzed using Python 3 programming language: a relatively simple and effective data treatment, and general-purpose language, with a collection of libraries, compatible with Microsoft Excel files. The program first reads the preliminary data from the Excel files, rearranges, and processes the readable data, sorts the questionnaire results and the experts/respondents' responses, assigns relative weights according to specializations, and represents in another Excel file, pointing out specializations, weights/importance, according to sustainability dimensions, and key aspect. The processed data is written in an easy-to-analyze manner and arranged according to the dimensions and the sub-aspects.

Figure 3 sums up the statistical analysis of the participants' reactions toward sustainability dimensions, and the closely related key aspects, indicating the relative weights and ranking. The experts and participants collectively emphasized the importance of social and cultural aspects, ranked relatively top-most (8) points/grades, including urban value and social capital, and the aspects of viability, safety and security, and identity, scored 7 grades, followed by the aspects of, local environment, and urban design patterns, scoring 6 grades. In the middle ranking of importance were the partially physical and economic aspects, namely, land uses, mobility structure, local climate, and economic structure, scoring level (5) ranking of relative importance. Figure 3 also shows the respondents' reactions, according to their realms of specialization, namely, group 1; architecture, urban design and planning, and landscape design, and group 2; social sciences and humanities.

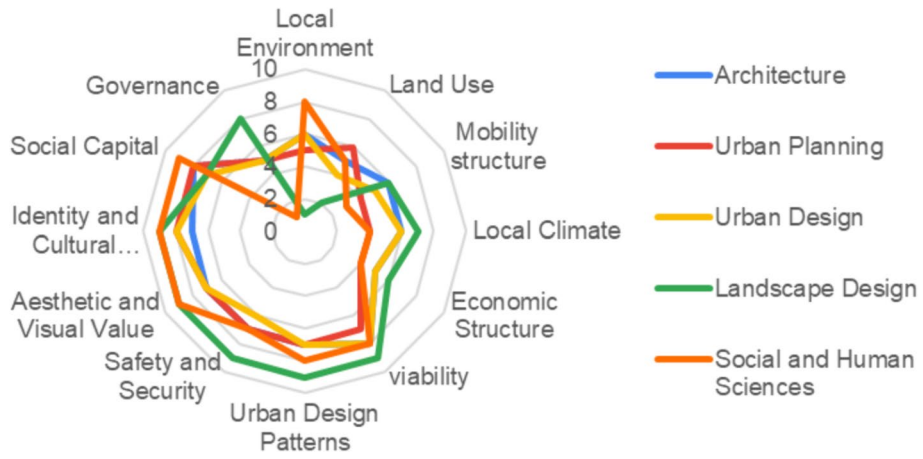

Fig. 3 The "proposed framework" validation—the relative importance of the main aspects, according to the participants' specializations

Furthermore, Fig. 4 presents the statistical analysis of the participants' reactions toward the relative weight and importance of each criterion (key aspects related) in achieving and realizing "spontaneous sustainability" using the Saaty scale [45]. The results of the survey of experts' ranking and interacting with the "proposed framework", emphasized the importance of social and cultural criteria in securing "sustainability", hence the propositions of "spontaneous" drives of distinct communities. They stressed the criteria related to community features, character and identity, and continuity. Top-most are the issues and notions of visual and aesthetic value, heritage and cultural identity, socio-cultural practices, aesthetics of urbanism and architecture, social commitment, scoring 9 grades, as well as the culturally related physical criteria of urban density and cohesion, collectively enhancing continuity, identity, and place-attachment, scoring 7–8 grades, followed by the criteria of appropriate location, location quality, urban network, climate adaptation, accessibility, and communication, scoring 6 grades.

Social sciences and humanities participating experts emphasized the relative importance of the criteria: basic needs, communication and continuity between individuals and communities, physiological needs, health care and education, housing stability, services and facilities, and social security in achieving "spontaneous sustainability".

The results of the experts' interaction with the proposed framework, and questionnaire, further pointed out agreement regarding the "least important" criteria, including those of overlap and diversity of land uses, the hierarchy of open spaces, proximity and accessibility to the transportation network, local community contribution, scoring 3–4 grades. They also suggested that the criteria of proximity and accessibility to the transportation network, using local sources and resources, insurance and social equity, and community participation are not directly related to the "Framework" objectives, and may be taken out from the proposed framework.

Table 11 presents the developed "proposed framework" comprising the four levels of sustainability: dimensions, key aspects, criteria, and indicators, and highlights the relative weights and importance, given to the key aspects and related criteria.

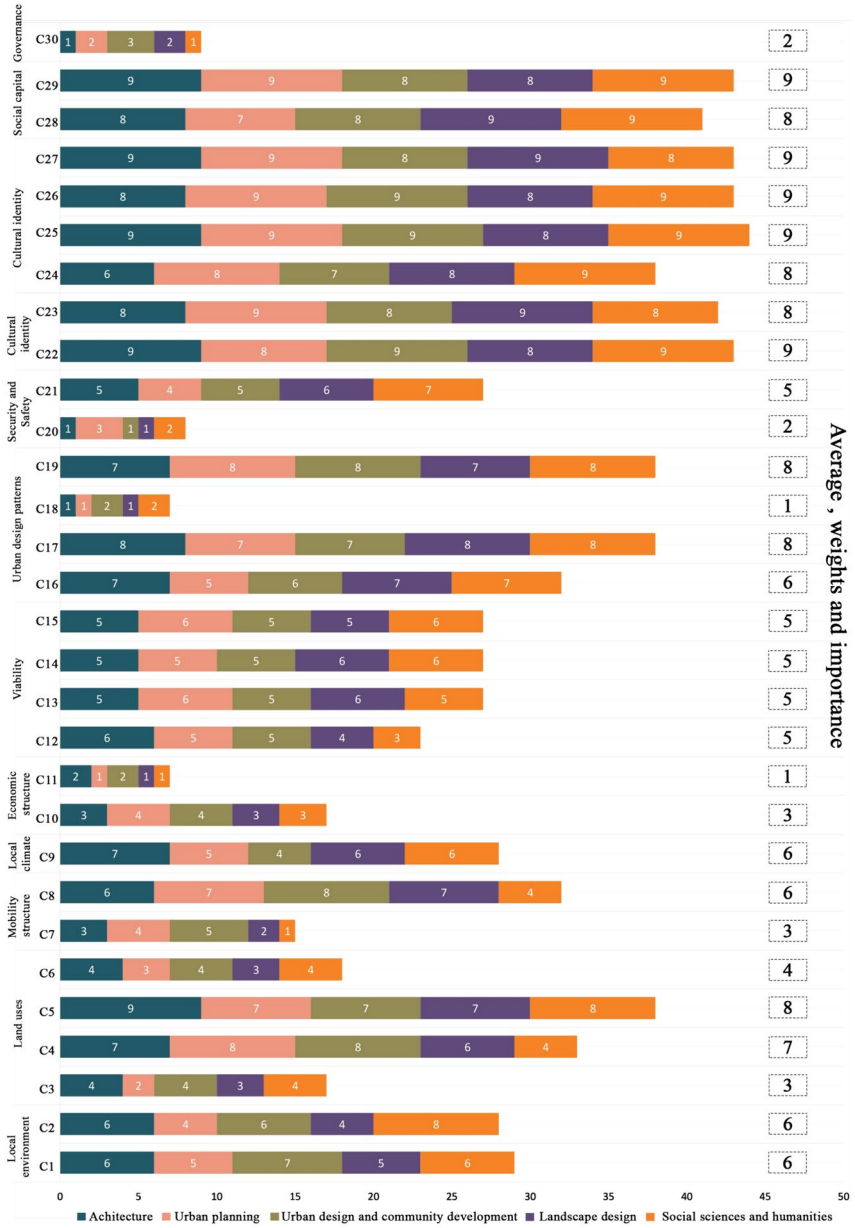

Fig. 4 The "Proposed Framework" validation—the relative importance of criteria, according to the participants' specializations

To allow the "proposed framework" to be applied, and further developed; an evaluation scale of the presence, and quality of the governing key aspects and criteria, is added, to enable, monitoring and assessing "spontaneous sustainability" of distinct communities and settings (Table 11). Hence providing a field tool combining two action-levels, namely monitoring, and qualitative assessment, as well as allowing interaction with local distinct communities, seeking their assessment of related settings, features, and potential, as pointed out earlier in the Introduction.

Conclusions

The present work presented the concept and notion of "spontaneous sustainability", as the informal, and unplanned "sustainable development" of communities, pointing out its potential as bases and framework, to complement, and support the agendas and drives of formal "sustainability". The proposition was emphasized by highlighting "culture" and components, as a well-recognized dimension in "sustainable" development and drives, together with the earlier, readily recognized dimensions, environmental, social, and economic.

The research, presented, and followed the said notion, and conception of "spontaneous sustainability" of distinct communities, that managed to continue, survive, and develop, in their traditional settings, and away from, bearing and enjoying, the merits of formal "sustainability".

The present research is part of an investigation into the "spontaneous sustainability" of those communities, a prelude, with a main objective, to formulate a "framework", to follow, monitor, assess, and enhance. The developed "framework" provides a tool, suitable for fieldwork, allowing interaction with the targeted communities, rendering support, and integration into the formal drives of "sustainable" development.

The research secured the said objective, of formulating, developing, and validating, the targeted "framework" for monitoring and enhancing the "spontaneous sustainability" of distinct communities, characterized by, historic depths, continuity, quality culture, and products.

The research recalled and deployed, the conception and drives of "sustainability" and development, and the related representational models, and systems, emphasizing its governing three principal dimensions; environmental, social, and economic, together with "culture", the encompassing, and added fourth, providing the context and container for the other development dimensions, and reflecting communities' features and characteristics.

The target "spontaneous sustainability" framework was formulated and developed, through a rational sequence, deploying selected international, "formal sustainability" systems and agendas—presenting and integrating its components: dimensions, key aspects, criteria, and indicators, emphasizing, social and cultural dimensions, and related scale of application. The formulation procedure incorporated 3 phases—collectively covering the formulation of "sustainability" preliminary frameworks, incorporating, and leading sustainability assessment systems, later development of the said systems, and approaches addressing social and cultural sustainability. The preliminary frameworks were combined and integrated, emphasizing the social and cultural dimensions, and leading to the "proposed framework" (Table 10).

The "proposed framework" was validated in the concluding "phase", through a limited survey, of local experts, who reviewed and assessed, the research "propositions", and method of formulating the targeted "framework", together with the preliminary frameworks 1, 2, and 3, as well as the "proposed framework" for monitoring and enhancing "spontaneous sustainability" (Table 10).

The experts accepted the research propositions and products, agreed with and endorsed the procedure to realize its objective and the sequence to formulate the targeted "framework". They interacted with the resulting "proposed framework",

Table 10 The proposed framework—monitoring and enhancing "spontaneous sustainability"

Dimensions	Key aspects	Criteria		Indicators		Evaluation scale								
						Importance, and relative weight →								
						Low		Medium			High			
						1	2	3	4	5	6	7	8	9
Physical/environmental	Local environment	C1	Appropriate location	Identifying urban space	[42]									
				Spatial privacy										
				Harmony with the urban surroundings of the city										
		C2	Location quality	Clarity of place element	[46]									
				Respecting local identity										
	Land uses	C3	Overlap and diversity of land uses	Equitable distribution of use										
				Mixed-use	[42]									
				Adaptation and functional flexibility										
		C4	Urban density	Flexibility of use and scalability	[47]									
		C5	Urban cohesion	Compatibility with urban development	[48]									
				Interaction with the context										
				Local identification possibility										
				Connected neighborhoods										
		C6	The hierarchy of open spaces	The clarity of the urban structure and its gradation	[42]									
	Mobility structure	C7	Urban network	Availability of a traffic/pedestrian support network	[49]									

Table 10 (continued)

Dimensions	Key aspects	Criteria		Indicators	Evaluation scale								
					Importance, and relative weight →								
					Low		Medium			High			
					1	2	3	4	5	6	7	8	9
				Efficiency of the streets network (paved streets network)									
		C8	Proximity and accessibility to the transportation network	Access to public transportation	[30]								
				Availability of public transportation									
	Local climate	C9	Climate adaptation	External and internal thermal comfort	[29, 42]								
				Resistance to environmental influences (negative)									
Economic	Economicstructure	C10	Local community contribution	Arts and local crafts	[50, 51]								
		C11	Using local sources and resources	Exploiting the resources and re-employing the architectural heritage	[52]								
Social and cultural	Viability	C12	Physiological needs	Providing basic needs (food, housing, and health)	[30]								
		C13	Health care and education	Proximity of on-site health and education care	[51, 52]								
		C14	Housing stability	Providing adequate housing	[30, 41]								
		C15	Services and facilities	Providing the infrastructure for services and facilities	[23]								

Table 10 (continued)

Dimensions	Key aspects	Criteria		Indicators	Evaluation scale								
					Importance, and relative weight →								
					Low		Medium			High			
					1	2	3	4	5	6	7	8	9
	Urban design patterns	C16	Accessibility and communication	Communication and social interaction within the place/community communication	[42]								
		C17	Diversity of housing patterns	The provision of different—levels of housing	[30]								
		C18	Proximity of housing and work	Local labour market/providing job opportunities	[28, 41]								
		C19	Social formation pattern	Urban planning and fabric	[32, 35]								
				Tribal affiliation-behavior patterns and values									
	Security and safety	C20	Insurance and social equity	Gender equality and justice	[32]								
				Insurance and social and economic justice									
		C21	Social security	Secure streets and open spaces	[53, 54]								
	Urban value	C22	Visual and aesthetic value	Architectural and urban character	[35]								
				External surface treatments									
		C23	Sense of belonging	Community stability	[35, 51]								
				The sense of place identity									
	Cultural identity	C24	Assets and background	Using cultural and natural assets	[30]								
		C25	Heritage and cultural identity	Non-material community heritage/social memory	[54]								
		C26	Socio-cultural practices	Tangible and intangible cultural practices	[44]								

Table 10 (continued)

Dimensions	Key aspects	Criteria		Indicators		Evaluation scale								
						Importance, and relative weight								
						Low		Medium			High			
						1	2	3	4	5	6	7	8	9
		C27	Aesthetics of urbanism and architecture	Architectural character	[2]									
				Urban form/ townscape										
	Social capital	C28	Sense of social belonging	Social interaction and connection to the place	[43]									
				Quality of life and social justice										
		C29	Social commitment	Social mingling, communication, and integration	[43, 44]									
				The strength of social ties										
Institutional	Governance	C30	Community participation	Community awareness	[32]									
				Participation and interactions in social roles										

Table 11 Developed, proposed framework—monitoring and enhancing "spontaneous sustainability"

Level 1 dimensions	Level 2	Level 3			Level 4	Presence and quality				
	key aspects	Criteria			Indicators	1	2	3	4	5
Physical/environmental	Local environment	○	C1	Appropriate location	Identifying urban space					
					Spatial privacy					
					Harmony with the urban surroundings of the city					
		◐	C2	Location quality	Clarity of place elements					
					Respecting local identity					
	Land uses	○	C3	Overlap and diversity of land uses	Equitable distribution of uses					
					Mixed-use					
					Adaptation and functional flexibility					
		●	C4	Urban density	Flexibility of use and scalability					
		●	C5	Urban cohesion	Compatibility with urban development					
					Interaction with the context					
					Local identification possibility					
					Connected neighborhoods					
		○	C6	The hierarchy of open spaces	The clarity of the urban structure and its gradation (public, semi-public, private)					
	Mobility structure	◐	C7	Urban network	Availability of a traffic/pedestrian support network and its relevance					
					Efficiency of the streets network (paved streets network)					
	Local climate	○	C9	Climate adaptation	External and internal thermal comfort					
					Resistance to environmental influences (negative)					
Economic	Economic structure	○	C10	Local community contribution	Arts and local crafts					
Social and cultural	Viability	◐	C12	Physiological needs	Providing basic needs such as (food, housing and health)					
		◐	C13	Health care and education	Providing and proximity of on-site health and education care					

Table 11 (continued)

Level 1 dimensions	Level 2	Level 3			Level 4	Presence and quality				
	key aspects	Criteria			Indicators	1	2	3	4	5
		◐	C14	Housing stability	Providing adequate housing					
		◐	C15	Services and facilities	Providing the infrastructure for services and facilities					
	Urban design patterns	◐	C16	Accessibility and communication	Communication and social interaction within the place/community communication					
		◐	C17	Diversity of housing patterns	The provision of different levels of housing in terms of ownership, acquisition, and cost					
		●	C19	Social formation pattern	Urban planning and fabric					
					Tribal affiliation—behavior patterns and values					
	Security and safety	◐	C20	Social security	Secure streets and open spaces					
	Urban value	●	C22	Visual and aesthetic value	Architectural and urban character					
					External surface treatments					
		●	C23	Sense of belonging	Community stability					
					The sense of place identity					
	Cultural identity	●	C24	Assets and background	Using cultural and natural assets					
		●	C25	Heritage and cultural identity	Non-material community heritage/social memory					
		●	C26	Socio-cultural practices	Tangible and intangible cultural practices					
		●	C27	Aesthetics of urbanism and architecture	Architectural character					
					Urban form/townscape					
	Social capital	◐	C28	Sense of social belonging	Social interaction and connection to the place					
					Quality of life and social justice					
		◐	C29	Social commitment	Social mingling, communication, and integration					
					The strength of social ties					

1 lacking/critical, *2* low/unsatisfied, *3* medium, *4* acceptable/good, *5* very good

● Important criteria

◐ Medium-importance criteria

○ Fair/required criteria

pointing out its clarity, ease of usage, and flexibility; assessing and suggesting the relative weights and importance of its components: key aspects, criteria, and indicators (Figs. 3 and 4).

The developed "framework" (Table 11) provides the basis for an integrated part of the present work, namely, to apply selected culturally distinct communities and settings, to monitor and assess the presence and quality of "sustainability" dimensions, aspects, criteria, and indicators, emphasizing the social and cultural. As presented earlier, it can indirectly benefit the "Nubian" and other distinct communities, at times on the margins of mainstream "Sustainability" drives, acknowledging their potential, following and allowing means of integration.

The proposed "framework" provides the involved partners and actors, in community design and development, professionals and decision-makers, with a flexible, open-ended tool, to deploy at the various stages of community development. The sources deployed to formulate, the "preliminary frameworks" and leading to the "proposed", could be further expanded, allowing comparative analysis, and assessment of the adopted "criteria" and indicators.

Furthermore, fieldwork and applications, of the "proposed framework" point out future research, allowing further testing and validation of the research propositions regarding informal and unplanned "spontaneous sustainability" and its potential to complement, enhance, and be integrated into "formal sustainable development" systems, plans, and drives.

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Notes
Link to Online Questionnaire: https://forms.gle/VMD2vam65FhyXxJ77

Authors' contributions
All authors collectively contributed to the work conception, propositions, objective definition, methodology, and realization. GIH is the corresponding author, carried out a literature survey, and data collection, prepared the manuscript drafts, and conducted the validation survey and analysis. SE and NA reviewed, edited, and finalized the manuscript. All authors read and approved the final manuscript.

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Declarations

Ethics approval and consent to participate
This is to confirm that the presented manuscript adheres to and follows Springer's rules on Ethics Approval and Consent to Participate, and Publication.
The presented manuscript and the questionnaire it deployed do not contain any individual person's data in any form.
The manuscript does not make any reference to any individual participant's views or opinions. All the references, statements, and coverage of the questionnaire in the manuscript are collectively presented, as summing up results, qualitative statistics, and figures.
All respondents to the questionnaire are experienced academics and professionals, graduates with 5 years or more of experience.
All participants agreed and consented to participate by completing and sending the questionnaire online.
The purpose of the questionnaire was clearly stated and presented as the opening statement, pointing out that it is part of a doctoral thesis, and it will also be part of academic research to be presented for publication, and specifically asked for approval and consent of the participant to use the collective results of the questionnaire, in the doctoral thesis, and related research publication."

Consent for publication
Not applicable as no individual person's data in any form is presented.

Competing interests
The authors declare that they have no competing interests.

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